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SPORT EFFORTS FOR AND HARVESTS OF COHO AND CHINOOK SALMON, HALIBUT, AND LINGCOD IN RESURRECTION BAY SPORT FISHERIES, ALASKA, DURING 1988[1]

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF FIGURES

LIST OF APPENDIX TABLES

ABSTRACT

An estimated 6,654 boat-trips of sport fishing effort were expended in the marine boat fishery in Resurrection Bay from 1 July through 14 September 1988. This fishery harvested an estimated 9,809 coho salmon *Oncorhynchus kisutch*, 2,749 halibut *Hippoglossus stenolepis*, 2,157 lingcod *Ophiodon elongatus*, and 89 chinook salmon *Oncorhynchus tshawytscha*. About half the effort (41 percent) and harvest of coho salmon (47 percent) occurred during the 9-day Seward Silver Salmon Derby. Over 40 percent of the harvest of coho salmon were stocked fish with the Bear Lake, Seward Lagoon, and Lowell Creek stocking sites having contributed 6, 21, and 16 percent of the coho salmon harvested, respectively. The majority of coho salmon harvested in the boat fishery were age 1.1 (66 percent).

Estimated effort and harvest in the beach fishery for coho salmon in Resurrection Bay were 16,779 angler-hours and 4,718 fish, respectively. About 80 percent of the harvested coho salmon in this fishery were stocked fish with the Bear Lake, Seward Lagoon, and Lowell Creek stocking sites having contributed 0, 44, and 37 percent of the coho salmon harvested, respectively. Similar to the boat fishery, the majority of the coho salmon harvested in this fishery were age 1.1 (72 percent).

In the beach fisheries for chinook salmon in Resurrection Bay, estimated effort and harvest were 10,834 angler-hours and 1,322 fish, respectively. The majority of harvested chinook salmon in the beach fisheries were age 0.3 (89 percent). It is assumed that all the harvested chinook salmon were hatchery-reared stocked fish.

KEY WORDS: coho salmon, *Oncorhynchus kisutch*, chinook salmon, *Oncorhynchus tshawytscha*, halibut, *Hippoglossus stenolepis*, lingcod, *Ophiodon elongatus*, Resurrection Bay, sport effort, sport harvest, age, length, hatchery contribution.

INTRODUCTION

The recreational fishery in Resurrection Bay is one of the largest marine sport fisheries in Alaska (Mills 1988). Historically, most of the effort in this fishery has been by private boat anglers; however, a growing charter industry and recreational boating by military personnel have also developed in recent years. Collectively, effort in the boat fishery has averaged nearly 7,400 boat-trips annually from 1968 to 1988 (Table 1). Historically, most of the effort by the boat fishery has targeted coho salmon *Oncorhynchus kisutch*. In recent years, however, local stocks of halibut *Hippoglossus stenolepis*, lingcod *Ophiodon elongatus*, rockfish *Sebastes spp.*, and chinook salmon *O. tshawytscha* are being increasingly targeted. Harvests of coho salmon in the boat fishery from 1968 through 1987 have averaged about 15,600 coho salmon annually (Table 1). In addition to the boat fishery, anglers also fish from shore for coho and chinook salmon. Effort and harvest in the shore fishery, although increasing annually, are small compared to the boat fishery.

To increase and stabilize the numbers of coho salmon available to the sport fisheries in Resurrection Bay, a stocking program for coho salmon was initiated in 1962 (Figure 1). Bear Lake was chosen as the initial focus of the stocking effort. To increase the rearing capacity of the lake for young coho salmon, the lake was rehabilitated to eradicate competing threespine stickleback *Gasterosteus aculeatus* and an annual stocking of coho salmon fingerlings was begun. Survivals of fingerlings to smolts from these efforts have averaged 35% since 1971 (Vincent-Lang 1988). Bear Lake also supports a small run of sockeye salmon *O. nerka* which, in past years, has contributed to both commercial and personal-use fisheries.

Additional stockings of coho salmon in Resurrection Bay began in 1968 with annual releases of hatchery-reared smolts of Bear Lake origin at other sites. Release sites have varied annually and have included Seward Lagoon, the Lowell Creek outfall, Grouse Lake, and Bear and Box Canyon Creeks. Hatchery-reared chinook salmon smolts have also been released annually since 1983 in an effort to lengthen and diversify the Resurrection Bay sport fishery.

In conjunction with the stocking program, the Alaska Department of Fish and Game, Sport Fish Division, has conducted an ongoing research program with the objectives of: (1) monitoring effort and harvest in the sport fisheries in Resurrection Bay; (2) estimating the return of stocked fish; and (3) determining the most effective stocking strategies. These objectives have principally been accomplished through research aimed at monitoring the three major life history events of stocked salmon in the Resurrection Bay drainage: (1) freshwater residency and emigration; (2) harvest in the marine sport fishery; and (3) immigration. Numbers (1) and (3) are currently accomplished by operating weirs on the outlets of Bear Lake and Seward Lagoon (Figure 1) to collect data needed to estimate the abundance and biological characteristics (age, sex, and size composition) of the smolt emigrations (Bear Creek only) and the adult salmon immigrations. Number (2) is currently accomplished through a creel survey designed to estimate angler-effort and harvest of coho salmon by the sport fishery in Resurrection Bay, the biological characteristics of harvested salmon, and the site-specific (by stocking location) contribution of stocked salmon to the harvest.

Table 1. Harvest and effort statistics for the Resurrection Bay boat fishery for coho salmon, 1968-1988.

	Effort		Harvest			
Year	Boat-Trips	Standard Error	Number	Standard Error	95% Confidence Interval	
1968	8,518	89.3	22,932	744.7	21,473 -	24,392
1969	7,717	160.6	14,444	585.2	13,297 -	15,591
1970	8,921	133.9	15,027	555.8	13,938 -	16,116
1971	8,041	110.8	19,264	754.3	17,786 -	20,743
1972	9,297	183.1	15,383	760.0	13,894 -	16,873
1973	7,730	117.6	13,931	579.8	12,795 -	15,068
1974	7,520	141.3	17,550	839.0	15,906 -	19,195
1975	5,351	108.1	16,817	892.2	15,068 -	18,566
1976	5,953	87.7	8,861	441.7	7,995 -	9,727
1977	7,113	131.6	16,003	601.8	14,824 -	17,182
1978	6,280	124.0	15,819	617.0	14,610 -	17,029
1979	7,163	151.0	16,532	779.9	15,003 -	18,060
1980	7,657	191.4	18,918	1,079.1	16,803 -	21,033
1981	6,682	134.4	14,087	785.6	12,548 -	15,627
1982	7,948	164.5	16,160	929.7	14,338 -	17,982
1983	8,479	139.9	13,780	897.1	12,022 -	15,538
1984	6,996	128.7	10,445	627.4	9,215 -	11,674
1985	6,848	209.6	10,332	765.7	8,832 -	11,833
1986	5,950	274.7	13,107	759.4	11,618 -	14,596
1987	7,661	352.4	22,224	1,325.0	19,627 -	24,821
Mean	7,391		15,594			
1988	6,654	228.0	9,809	676.4	8,483 -	11,135

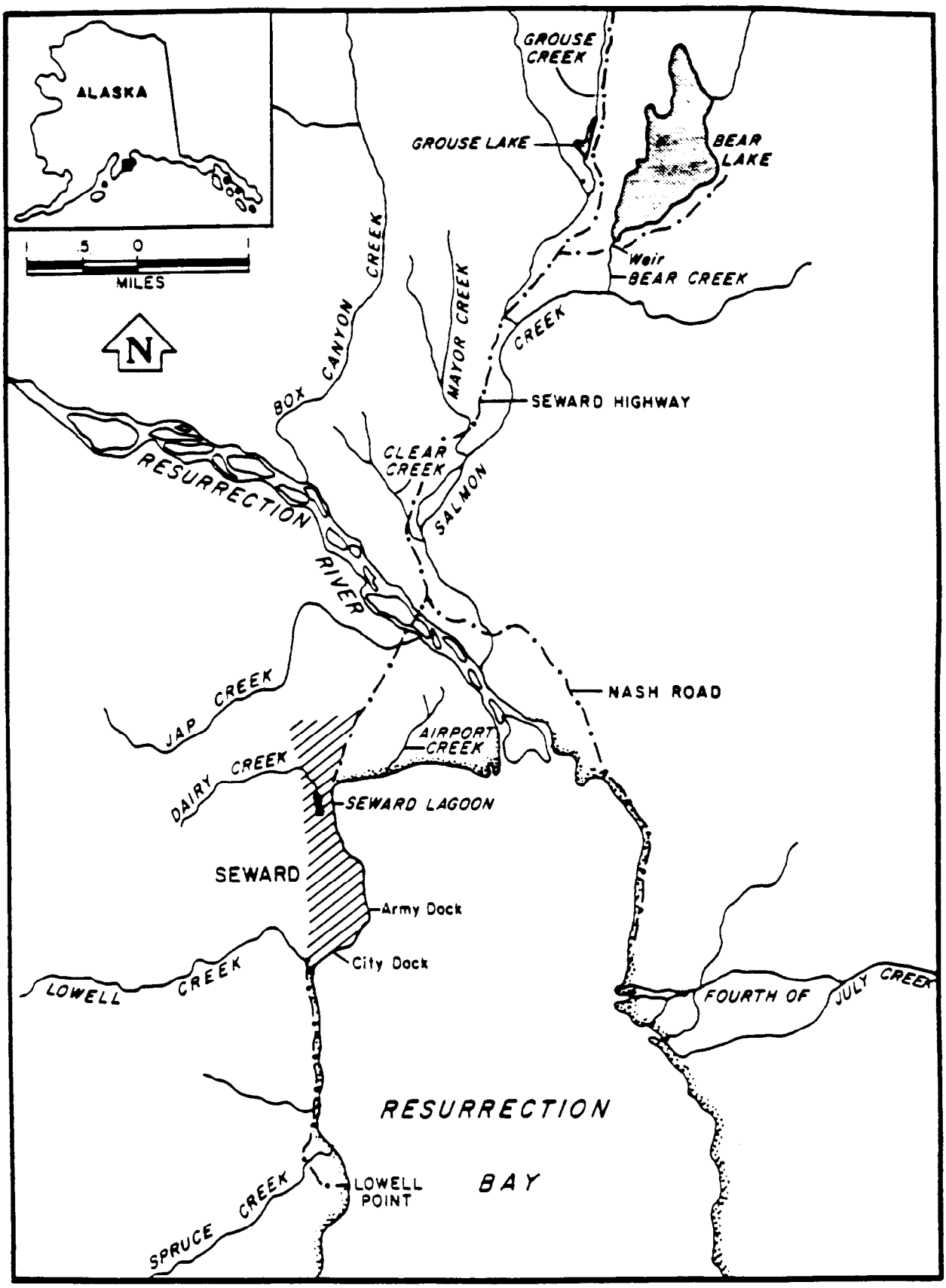

Figure 1. Map of Resurrection Bay, Alaska.

The objective of this report is to summarize data collected in conjunction with number (2) during 1988. Migrations and freshwater residency numbers (1) and (3) are the subject of a separate report (Carlon and Vincent-Lang in press). Vincent-Lang (1987, 1988) presents a complete summary of past stocking activities in Resurrection Bay, including estimates of survival rates and contributions to the sport fishery.

METHODS

The bag limit for coho, sockeye, chum *O. keta*, and pink *O. gorbuscha* salmon in combination in Resurrection Bay during 1988 was six per day, six in possession (ADF&G 1988). The bag limit for chinook salmon, halibut, and lingcod was two each per day, two each in possession. Anglers could use any conventional sport fishing methods including snagging.

Boat Fishery Creel Survey

The boat fishery in Resurrection Bay was surveyed from 1 July through 14 September. The fishery was stratified into three temporal segments:

1. Pre-Derby boat fishery, 1 July - 12 August;
2. Derby boat fishery, 13 August - 1200 hour on 21 August; and,
3. Post-Derby boat fishery, 1201 hour on 21 August - 14 September.

Each segment was further stratified into weekdays and weekends/holidays.

The survey used a stratified random sampling design to estimate sport fishing effort in units of boat-trips and the numbers of coho and chinook salmon, halibut, and lingcod harvested by boat anglers. The fishing day was defined to be 14 hours long (from 0800 to 2200 hours) and each day was divided into four, 3.5-hour time periods: (A) 0800-1129 hours; (B) 1130 - 1459 hours; (C) 1500 - 1829 hours; and (D) 1830 - 2200 hours. Units to be surveyed were randomly selected without replacement from those available in each period subject to the constraint that a maximum of two sample units could be surveyed on any day (except during the Derby). Sampling effort was allocated optimally among periods based on standard errors of the effort estimates for each period and fishery segment in the years 1986 (Sonnichsen et al. 1987) and 1987 (Vincent-Lang et al. 1988).

Two people usually conducted the creel survey during each sampled period. One person counted all sport fishing boats entering the Seward small boat harbor and conducted interviews of boat anglers (hereafter referred to as "boat interviews") at two harbor exit sites. The second person assisted with interviews and biological sampling of the harvest. Anglers from as many returning boats as possible were interviewed. An equal amount of time was spent conducting interviews at each exit site when it was not possible to survey all returning boats.

All boat interviews were completed trip interviews. Interviews for effort and harvest information were party interviews for all anglers in a returning boat.

For each boat, the following information was collected: number of anglers in the boat; number of hours fished; total number of coho and chinook salmon, halibut, and lingcod harvested; and whether the boat was chartered or private. As many harvested coho salmon as possible were examined for an adipose finclip. If a finclip was observed, the fish's snout was removed (upon permission of the angler) and stored for later removal and decoding of the coded wire tag (CWT).

For each fishery segment (Pre-Derby, Derby, and Post-Derby) and stratum (weekday and weekend/holiday), the mean number of boats returning during each period (A, B, C, or D) was calculated. The number of boat-trips of effort in fishery stratum i (B_i) was estimated as:

$$\hat{B}_i = \sum_{j=1}^{4} N_{ij} \bar{b}_{ij}, \qquad (1)$$

where:

$\bar{b}_{ij}$ = the mean number of boats returning during period j in stratum i and

N_{ij} = the total number of sample units (3.5 hour time periods) possible during period j in stratum i.

The variance of $\hat{B}_i$ was estimated as (Schaeffer et al. 1979):

$$V(\hat{B}_i) = \sum_{j=1}^{4} N^2_{ij} \, [s^2_{ij}/n_{ij}][1 - (n_{ij}/N_{ij})], \qquad (2)$$

where:

N_{ij} is defined as above,

n_{ij} = the total number of sample units surveyed during period j in fishery stratum i, and

s^2_{ij} = the sample variance for the mean number of boats returning during period j in fishery stratum i.

The total number of boat-trips for the Resurrection Bay fishery was estimated by summing the estimates for each stratum for all segments of the fishery. These are considered independent estimates and the estimated variance of the total is the sum of the variances.

Harvest per unit effort ($\overline{HPB}_i$) was estimated as mean harvest per boat-trip for each stratum in each fishery segment as:

$$\overline{HPB}_i = \left(\sum_{k=1}^{t_i} h_{ik}\right)/t_i \, , \qquad (3)$$

where:

t_i = the total number of boats interviewed during stratum i and
h_{ik} = the harvest of coho salmon by boat k interviewed during stratum i.

$\overline{HPB}_i$ was estimated by a two-stage sample design with days being the first stage sample unit (of which there are a finite number available to be sampled) and boats being the second stage sample unit (of which there are an unknown number available to be sampled on any given day).

The variance of $\overline{HPB}_i$ was estimated as (Von Geldern and Tomlinson 1973):

$$V(\overline{HPB}_i) = [1 - (d_i/D_i)]\, s_B^2/d_i + (\sum_{j=1}^{d_i} s_{ij}^2/m_{ij})/d_i D_i \ , \qquad (4)$$

where:

d_i = the number of days in stratum i during which interviews were conducted,
D_i = the total number of days in stratum i,
s_B^2 = the between-day variance of $\overline{HPB}_i$ in stratum i,
s_{ij}^2 = the sample variance of $\overline{HPB}_{ij}$ on day j in stratum i, and
m_{ij} = the number of boats interviewed during day j of stratum i.

Between-day variance was calculated as:

$$s_B^2 = [\sum_{i=1}^{d_i} (\overline{HPB}_{ij} - \overline{HPB}_i)^2]/(d_i - 1). \qquad (5)$$

The number of coho salmon harvested during the weekday or weekend/holiday stratum of each fishery segment (H_i) was calculated as follows:

$$\hat{H}_i = \hat{B}_i \overline{HPB}_i \ . \qquad (6)$$

The variance of this estimate was estimated using the formula for the product of two independent random variables (Goodman 1960):

$$V(\hat{H}_i) = [\hat{B}_i^2\, V(\overline{HPB}_i)] + [\overline{HPB}_i^2\, V(\hat{B}_i)] - [V(\hat{B}_i)\, V(\overline{HPB}_i)] \ . \qquad (7)$$

The total coho salmon harvest by all segments of the boat fishery ($\hat{H}_T$) was estimated as:

$$\hat{H}_T = \sum_{i=1}^{6} \hat{H}_i \qquad (8)$$

where i is one of six fishery strata. Because these are independent estimates, the estimated variance of the total is the sum of the variances. Harvests of other species were estimated using these same procedures.

Number of boat-trips and the harvests of coho and chinook salmon, halibut, and lingcod by military personnel and their dependents were obtained from dispatch officers at the military recreation camps. Data collected from dispatch officers represent a census of harvest and effort by military personnel except where records were unavailable.

Assumptions necessary for the creel survey of the boat fishery include:

1. Surveyed boats were representative of the total population of fishing boats.

2. No significant fishing effort occurred between the hours 2200 and 0800.

3. Boat counts and harvest per boat were normally distributed random variables.

Beach Fishery Creel Survey

A roving creel survey (Neuhold and Lu 1957) was used to count anglers and conduct angler interviews at selected Resurrection Bay shore locations. The creel survey followed a stratified random sampling design. Angler counts were used to estimate fishing effort in units of angler-hours. Angler interviews were used to estimate the harvest rates of chinook and coho salmon. These fisheries are directed at chinook salmon during June and early July and at coho salmon during late August and early September.

The beach fishery for chinook salmon was surveyed from 3 June through 10 July and was divided into two areas: (1) the Lowell Creek outfall or waterfall beach; and (2) the boat harbor beach. The beach fishery for coho salmon was surveyed from 13 August through 27 September and included only one area, the Seward beach area[1]. Each beach fishery was further stratified by weekdays and weekends/holidays. The fishing day was defined to be 14 hours long and was stratified into the same daily time periods used for the boat fishery. Sampling effort was allocated approximately equally over time periods.

[1] The Lowell Point and Fourth of July beach fisheries were surveyed in 1986 (Sonnichsen et. al. 1987). These fisheries target primarily on pink salmon and few coho salmon are harvested. No significant effort or harvest was detected at these areas by periodic monitoring during surveys of the Seward area beaches in 1988. Therefore they were not surveyed in 1988.

Optimal allocation of sampling effort among periods was not attempted because this is a developing fishery and regular use patterns have not been established.

For surveys during the coho salmon fishery, 3.5 hours were spent surveying the beach. However, for surveys during the chinook salmon fishery, 1.5 hours were spent at each beach during each sampled time period. The beaches were surveyed in random order and the angler count was conducted during a randomly selected 10 minute interval at each beach. Individual anglers were contacted during the survey and the following information was collected: the number of hours fished, the number of fish harvested and released by species, and whether the interview was a completed-trip interview or not. The majority of the interviews were incomplete trip interviews.

The total number of angler-hours ($\hat{E}_i$) for fishery stratum i in any beach fishery was calculated in the following manner:

$$\hat{E}_i = \sum_{j=1}^{4} H_{ij}\bar{x}_{ij}, \tag{9}$$

where:

$\bar{x}_{ij}$ = the mean number of anglers for counts during period j of stratum i and
H_{ij} = the total number of hours possible for fishing in period j of stratum i.

The variance for the estimate of total effort was calculated in the following manner:

$$V(\hat{E}_i) = \sum_{j=1}^{4} H_{ij}^2 \, s_{ij}^2/n_{ij}, \tag{10}$$

where:

s_{ij}^2 = the sample variance for $\bar{x}_{ij}$ and
n_{ij} = the number of angler counts during period j of fishery stratum i.

Harvest per unit effort ($\overline{HPUE}$) was estimated as the harvest per angler-hour) for each stratum at each beach in the following manner:

$$\overline{HPUE}_i = \sum_{k=1}^{m_i} h_{ik} / \sum_{k=1}^{m_i} e_{ik}, \tag{11}$$

where:

m_i = the number of anglers interviewed during stratum i,
h_{ik} = the harvest of coho salmon by angler k interviewed during stratum i, and
e_{ik} = the effort (number of hours expended) by angler k at the time of the interview.

Omitting the finite population correction factor, the variance of $\overline{HPUE_i}$ was approximated in the following manner (Jessen 1978):

$$V(\overline{HPUE_i}) = (\bar{H}_i/\bar{E}_i)^2 \left[s_H^2/\bar{H}_i^2 + s_E^2/\bar{E}_i^2 - (2r_i s_H s_E/\bar{H}_i\bar{E}_i)\right], \quad (12)$$

where:

$\bar{H}_i$ = the mean harvest of coho salmon by anglers in stratum i,

$\bar{E}_i$ = the mean effort by anglers in stratum i,

s_H^2 = the two-stage variance of the mean harvest ($\bar{H}_i$),

s_E^2 = the two-stage variance of the mean effort ($\bar{E}_i$), and

r_i = the correlation coefficient for h_{ik} and e_{ik}.

The total coho salmon harvest ($\hat{H}_i$) for each stratum of the beach fisheries was calculated by:

$$\hat{H}_i = \hat{E}_i \overline{HPUE_i}. \quad (13)$$

The variance of $\hat{H}_i$ was estimated using the formula for the product of two random variables from Goodman (1960), provided earlier.

The harvest was estimated for all strata of the beach fisheries and then summed to estimate the total season harvest. These are considered independent estimates, therefore, the estimated variance of the total was the sum of the variances.

The major assumptions for the beach creel survey analyses include:

1. Incomplete trip angler interviews provided an unbiased estimate of completed-trip HPUE.[2]

[2] A sign test of the mean daily HPUE of incompleted and completed trip interviews showed there was no significant differences between the harvest rates of the two groups ($p = 0.27$).

2. Interviewed anglers were representative of the total angler population and anglers were interviewed in proportion to their abundance.

3. No significant fishing effort occurred between 2200 and 0800 hours.

4. For the angler interview data, effort and harvest were normally distributed random variables.

Biological Data

Biological data were collected from coho salmon harvested in the boat and beach fisheries and chinook salmon harvested in the beach fishery. The objective was to sample 150 coho salmon during each temporal segment of the boat fishery and as many coho and chinook salmon as possible from the beach fisheries. Sampled fish were measured for mid-eye to fork-of-tail length to the nearest millimeter. Scales were taken for aging from the preferred area (Clutter and Whitesel 1956) and mounted on adhesive-coated cards. The cards were thermohydraulically pressed against acetate cards and the resulting scale impressions were displayed on a microfiche projector for age determination.

The proportional age composition of the sport harvest was estimated for each fishery stratum. Letting $\hat{p}_{hi}$ equal the estimated proportion of age group h in stratum i, the variance of $\hat{p}_{hi}$ was estimated using the normal approximation to the binomial (Scheaffer et al. 1979):

$$V(\hat{p}_{hi}) = \hat{p}_{hi}(1-\hat{p}_{hi})/(n_{Ti}-1), \qquad (14)$$

where n_{Ti} is the total number of coho salmon sampled during stratum i.

The number harvested during a stratum was multiplied by the estimated age composition to estimate the number of fish harvested by age group. The variance of the number harvested by age group was estimated using Goodman's (1960) formula.

Mean length at age by sex and its variance were estimated using standard normal procedures.

Estimation of Hatchery Contributions to the Fishery

The contributions of hatchery-reared coho salmon stocked into Bear Lake, Seward Lagoon, and Lowell Creek to the boat and beach harvests were calculated using the procedure of Clark and Bernard (1987). For the boat fishery, the estimates were stratified by temporal segment with the Pre-Derby and Derby

temporal segments being pooled due to small sample sizes.[3] For the beach fishery for coho salmon, one estimate was derived for all time periods.

The contribution of stocked coho salmon by site under evaluation ($\hat{C}_s$) was estimated as:

$$\hat{C}_s = (m_1/m_2)\ (a_1/a_2)\ (\hat{H}_T/n_2)\ (\hat{m}_c/\theta_s) \qquad (15)$$

where $\hat{H}_T$ is as defined previously and:

n_2 = number of coho salmon examined in the boat or beach sport harvest,
m_1 = number of snouts from fish with adipose (Ad) finclips collected from the fishery and sent to the lab for processing that have a coded wire tag (CWT) present,
m_2 = number of snouts from fish with adipose finclips collected from the fishery and sent to the lab for processing that have decodable CWTs,
a_1 = number of fish with adipose finclips observed in the fishery,
a_2 = number of snouts from fish with adipose finclips collected from the fishery and sent to lab for processing that arrive at the lab,
m_c = number of snouts from fish with adipose finclips collected from the fishery, sent to the lab for processing, and decoded as a unique tag code,
θ_s = for each tag code, the proportion of the total fish released that were marked with a CWT at the time of stocking. For Bear Lake, θ_s is the proportion of coho salmon adults with Ad clips observed in the Bear Lake immigration.

The variance of $\hat{C}_s$ was calculated by:

$$V(\hat{C}_s] = [\hat{H}_T^2\ V(\hat{m}_c) + \hat{m}_c^2\ V(\hat{H}_T) - V(\hat{m}_c)\ V(\hat{H}_T)]\ [(m_1\ a_1)/(m_2 a_2 n_2 \theta_s)]^2 \qquad (16)$$

and the variance of $\hat{m}_c$ (Clark and Bernard 1987) was calculated as:

[3] The numbers of unmarked and adipose finclipped coho salmon observed during the Pre-Derby/Derby and Post-Derby segments of the boat fishery were compared with a chi-square statistic to determine if the proportions of finclipped fish present in the segments were equal. The proportions were significantly different ($p < 0.005$) and therefore, the hatchery contributions were estimated separately for these segments of the boat fishery.

$$V[m_c] = \left[\frac{m_2\,[m_2\text{-}1]\;a_2\,[a_2\text{-}1]\;n_2\,[n_2 - 1]\;\hat{C}_s\,[\hat{C}_s - 1]\theta_s^2}{m_1\,[m_1\text{-}1]\;a_1\,[a_1\text{-}1]\;\hat{H}_T\,[\hat{H}_T\text{-}1]} \right] + \left[\frac{m_2\;a_2\;n_2\;\hat{C}_s\;\theta_s}{m_1\;a_1\;\hat{H}_T} \right] - \left[\frac{(m_2\;a_2\;n_2\;\hat{C}_S\;\theta_s)^2}{(m_1\;a_1\;\hat{H}_T)^2} \right] . \quad (17)$$

The estimates for each of the stocking sites were summed to estimate the total number of stocked coho salmon in the harvests of the boat and beach fisheries. The variance of the total was the sum of the variances for the individual estimates plus the covariances for the three combinations of the three stocking sites possible. Covariance was estimated as (Clark and Bernard 1987):

$$\mathrm{Cov}(\hat{C}_{r1};\hat{C}_{r2}) = \hat{C}_{r1}\;\hat{C}_{r2} \left[\frac{m_1\;(m_2\text{-}1)\;a_1\;(a_2\text{-}1)\;\hat{H}_T\;(n_2\text{-}1)}{m_2\;(m_1\text{-}1)\;a_2\;(a_1\text{-}1)\;n_2\;(\hat{H}_T\text{-}1)} \right] \quad (18)$$

RESULTS

Boat Fishery Creel Survey

As in 1986 and 1987, most private and charter boats in the Resurrection Bay fishery returned during the C period in 1988. Effort during the C period totaled 2,953 boat-trips, accounting for 44.3% of the total effort (Table 2). Effort during the remaining three time periods was 1,722 boat-trips (25.9%), 1,498 boat-trips (22.5%), and 481 boat-trips (7.2%) for the B, D, and A periods, respectively. Effort by private and charter boats during the Derby segment of the fishery was 2,722 boat-trips, which was 40.9% of the total private and charter boat effort during the entire Resurrection Bay boat fishery (Table 3). Effort by private and charter boats during the Pre-Derby and Post-Derby segments were 2,442 boat-trips (36.7%) and 1,490 boat-trips (22.4%), respectively. Within each segment, the effort during weekends was slightly higher than effort during weekdays. Boats from the military recreation camps accounted for an additional 1,365 boat-trips during the entire fishery (Table 4).

The mean harvest of coho salmon per boat-trip for all civilian boat anglers (private and charter boats combined) ranged from 0.9 fish per boat-trip during weekends of the Pre-Derby segment to 1.8 fish per boat-trip during weekdays of the Derby (Table 5). The mean harvest of coho salmon per boat-trip for charter boat anglers was larger than estimates for private boat anglers in

Table 2. Estimated number of boat-trips by private and charter boat anglers, by period, for each segment of the Resurrection Bay boat fishery, 1988.

Segment	Period A	B	C	D	Total
PRE-DERBY					
Weekdays:					
Number of counts	3	6	17	10	36
Effort	20	240	558	360	1,178
Standard error	9.5	44.4	40.6	70.9	93.5
Weekends:					
Number of counts	3	4	9	9	25
Effort	65	292	555	352	1,264
Standard error	0.0	58.7	53.6	34.2	86.5
DERBY					
Weekdays:					
Number of counts	4	5	4	5	18
Effort	51	377	571	225	1,224
Standard error	5.9	0.0	30.8	0.0	31.3
Weekends:					
Number of counts	3	3	3	3	12
Effort	267	260	696	275	1,498
Standard error	84.4	0.0	0.0	0.0	84.4
POST-DERBY					
Weekdays:					
Number of counts	2	6	4	3	15
Effort	49	189	189	149	576
Standard error	6.5	29.4	55.0	27.1	68.3
Weekends:					
Number of counts	2	4	4	5	15
Effort	29	364	384	137	914
Standard error	0.0	123.0	83.7	25.1	150.9
TOTAL					
Number of counts	17	28	41	35	121
Effort	481	1,722	2,953	1,498	6,654
Standard error	85.4	146.3	124.5	87.0	227.5

Table 3. Summary of the number of boat-trips of effort by private and charter boat anglers during the Resurrection Bay boat fishery, 1988.

Segment	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
PRE-DERBY				
Weekdays	1,178	93.5	995 - 1,361	15.5%
Weekends	1,264	86.5	1,094 - 1,434	13.4%
Total	2,442	127.4	2,192 - 2,692	10.2%
DERBY				
Weekdays	1,224	31.3	1,163 - 1,285	5.0%
Weekends	1,498	84.4	1,333 - 1,663	11.0%
Total	2,722	90.0	2,546 - 2,898	6.5%
POST-DERBY				
Weekdays	576	68.3	442 - 710	23.2%
Weekends	914	150.9	618 - 1,210	32.4%
Total	1,490	165.6	1,165 - 1,815	21.8%
GRAND TOTAL	6,654	227.5	6,208 - 7,100	6.7%

Table 4. Number of boat-trips and harvest of coho salmon, chinook salmon, halibut, and lingcod by military anglers and their dependents in all segments of the Resurrection Bay boat fishery, 1988.

Segment	Number of		Number of Fish Harvested[1]			
	Boat-Trips	Anglers	Coho	Chinook	Halibut	Lingcod
PRE-DERBY						
Air Force Personnel	429	3,854	0	0	798	607
Army Personnel	609	3,233	...[2]	...[2]	...[2]	...[2]
Total	1,038	7,087	0[2]	0[2]	789[2]	607[2]
DERBY						
Air Force Personnel	42	452	0	0	89	32
Army Personnel	81	409	...[2]	...[2]	...[2]	...[2]
Total	123	861	0[2]	0[2]	89[2]	32[2]
POST-DERBY						
Air Force Personnel	104	891	0	0	187	131
Army Personnel	100	510	...[2]	...[2]	...[2]	...[2]
Total	204	1,401	0[2]	0[2]	187[2]	131[2]
GRAND TOTAL	1,365	9,349	0[2]	0[2]	1,074[2]	770[2]

1 Harvest includes only those fish reported as kept.

2 Army personnel harvest records were not available.

Table 5. Estimated mean harvest of coho salmon per boat-trip for each segment of the Resurrection Bay boat fishery, 1988.

Segment	Days d[1]	Days D[2]	Number of Interviews	Mean Harvest[3]	Standard Error
PRE-DERBY					
Weekdays:					
Private boat anglers	18	30	225	1.32	0.263
Charter boat anglers	18	30	90	2.07	0.501
All civilian anglers[4]	18	30	323	1.50	0.271
Weekends:					
Private boat anglers	13	13	373	0.78	0.093
Charter boat anglers	13	13	59	1.58	0.354
All civilian anglers[4]	13	13	440	0.88	0.091
DERBY					
Weekdays:					
Private boat anglers	5	5	578	2.08	0.419
Charter boat anglers	5	5	26	1.85	0.091
All civilian anglers[4]	5	5	607	1.85	0.089
Weekends:					
Private boat anglers	4	4	671	1.56	0.113
Charter boat anglers	4	4	14	2.21	0.939
All civilian anglers[4]	4	4	696	1.56	0.110
POST-DERBY					
Weekdays:					
Private boat anglers	8	14	100	1.59	0.460
Charter boat anglers	8	14	4	3.00	0.681
All civilian anglers[4]	8	14	114	1.64	0.472
Weekends:					
Private boat anglers	7	7	209	1.61	0.387
Charter boat anglers	7	7	15	0.80	0.511
All civilian anglers[4]	7	7	228	1.53	0.384

1 Number of days on which interviews were collected.

2 Number of days possible for collecting interviews.

3 Mean harvest includes fish reported as kept only.

4 Includes private and charter boat anglers, plus anglers who were not specified as private, charter, or military.

four of the six segments of the fishery. Relatively few charter boat anglers were interviewed, however, and the precision of the estimates for their mean harvests were correspondingly poor.

Daily summary statistics for angler effort and coho salmon harvest per boat-trip for interviewed anglers are presented in Appendix Tables 1 through 4. Daily summary statistics for harvest per boat-trip of other species harvested during the Resurrection Bay boat fishery are presented in Appendix Table 5.

The estimated harvest of coho salmon by anglers fishing on private and charter boats from 1 July through 14 September was 9,809 fish (Table 6). This is considered to be a good estimate of total harvest of coho salmon by boat anglers as military anglers have increasingly targeted primarily on bottom fish and other species in recent years. While Army personnel harvest records were not available, Air Force records show that no coho salmon were harvested by Air Force personnel in 1988. The largest harvest of coho salmon occurred during the Derby fishery. Private and charter boat anglers harvested 4,604 coho salmon during the Derby, which was 46.9% of the total coho salmon harvest. Harvest of coho salmon in each segment of the boat fishery corresponded approximately to the amount of effort expended in the segment (Figure 2).

Chinook salmon, halibut, and lingcod were also harvested by anglers during the boat fishery. While the chinook salmon harvest estimate was only 89 fish, the lingcod and halibut harvest totaled at least 2,927 and 3,823 fish, respectively (Tables 4 and 7). Because the creel survey began on 1 July (after the start of the halibut, lingcod, and chinook salmon fisheries in the Bay) and Army harvest records were not available, these estimates are considered a minimum estimate of the total harvest of these species. Air Force personnel harvest accounted for 770 lingcod and 1,074 halibut, respectively.

Beach Fishery Creel Survey

The beach fishery for chinook salmon was surveyed from 3 June to 10 July. The beach fishery for coho salmon was surveyed from 13 August to 27 September.

Chinook Salmon:

The weekday stratum of the beach fishery for chinook salmon received more effort than the weekend/holiday stratum at both the Waterfall and Boat Harbor beaches. Anglers fishing during weekdays expended 7,347 angler-hours of effort, or 67.8% of the total effort (Table 8). Of the four time periods, the most effort was expended during D period. Anglers fishing during the D period expended 3,402 angler-hours of effort, or 31.4% of the total effort. Efforts expended during the C, B, and A time periods were 2,934 angler-hours (27.1%), 2,554 angler-hours (23.6%), and 1,944 angler-hours (17.9%), respectively. Of the two beaches, the waterfall beach received the largest amount of angler effort with an estimated 5,801 angler-hours or 53.5% of the total effort (Table 9, Figure 3). The boat harbor beach received 5,033 angler-hours of effort or 46.5% of the total effort. Daily angler counts at each beach are summarized in Appendix Table 6.

Table 6. Estimated number of coho salmon harvested by private and charter boat anglers during each segment of the Resurrection Bay boat fishery, 1988.

Segment	Harvest[1]	Standard Error	95% Confidence Interval	Relative Precision
PRE-DERBY				
Weekdays	1,761	347.6	1,088 - 2,442	38.7%
Weekends	1,107	137.3	838 - 1,376	24.3%
Total	2,868	373.8	2,135 - 3,601	25.5
DERBY				
Weekdays	2,263	123.8	2,020 - 2,506	10.7%
Weekends	2,341	211.4	1,927 - 2,755	17.7%
Total	4,604	244.9	4,124 - 5,084	10.4%
POST-DERBY				
Weekdays	945	292.5	372 - 1,518	60.7%
Weekends	1,392	415.1	578 - 2,206	58.4%
Total	2,337	507.8	1,342 - 3,332	42.6%
GRAND TOTAL	9,809	676.4	8,483 - 11,135	13.5%

[1] Harvest includes only those fish reported as kept.

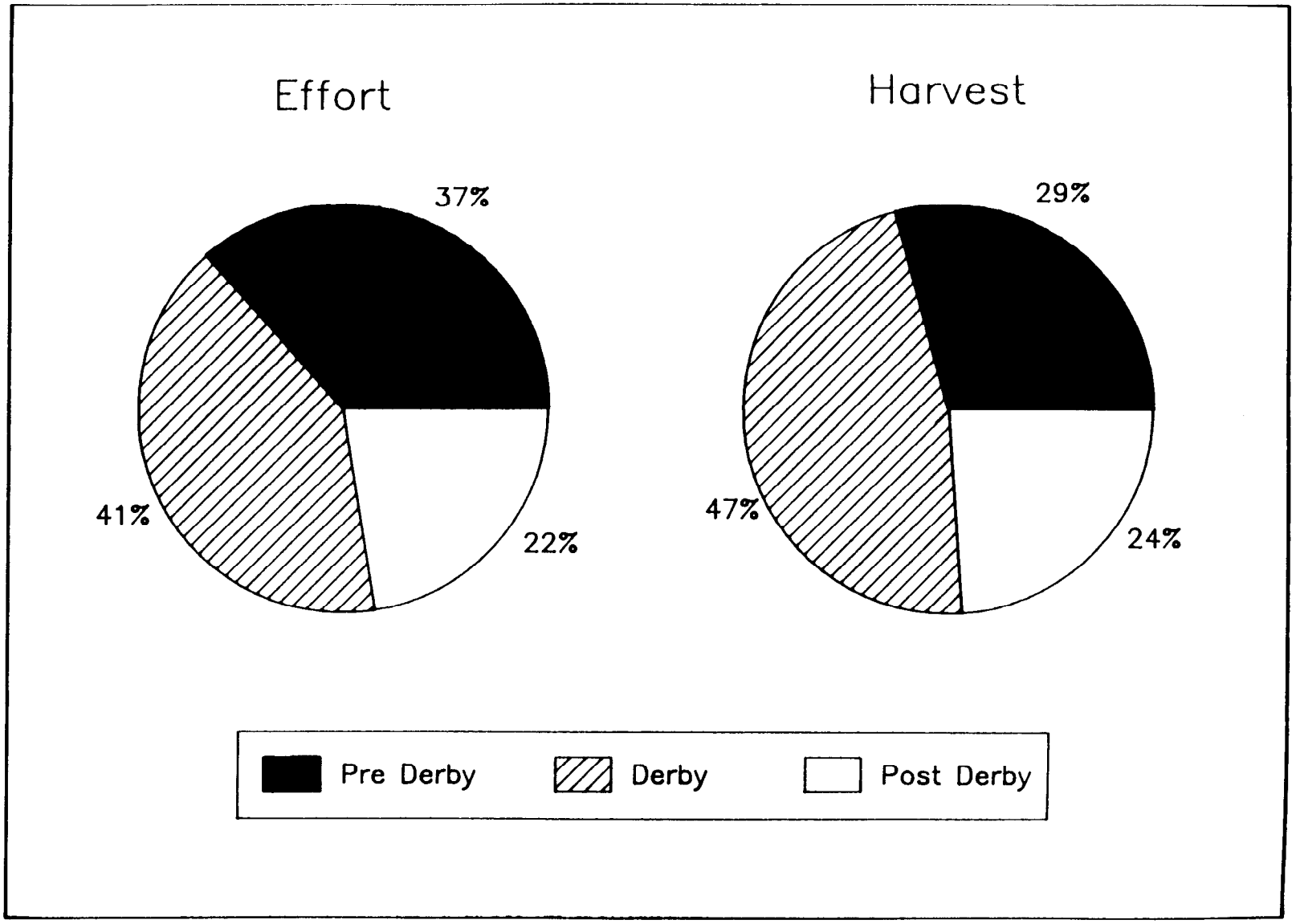

Figure 2. Percentage of coho salmon harvest and effort by private and charter boat anglers during each segment of the boat fishery in Resurrection Bay, 1988.

Table 7. Estimated number of chinook salmon, halibut, and lingcod harvested by private and charter boat anglers during the Resurrection Bay boat fishery, 1988.

Segment	Chinook Salmon		Halibut		Lingcod	
	Harvest	SE[1]	Harvest	SE[1]	Harvest	SE[1]
PRE-DERBY						
Weekdays	29	14.5	995	156.6	642	129.8
Weekends	3	4.2	1,231	150.6	730	136.8
Total	32	15.1	2,226	217.3	1,372	188.6
DERBY						
Weekdays	20	8.0	87	34.9	100	41.8
Weekends	13	5.4	232	45.4	237	47.8
Total	33	9.7	319	57.2	337	63.5
POST-DERBY						
Weekdays	0	0.0	60	39.1	96	79.1
Weekends	24	12.3	144	36.3	352	111.3
Total	24	12.3	204	53.4	448	136.5
GRAND TOTAL	89	21.8	2,749	231.0	2,157	241.3

[1] Standard error

Table 8. Estimated number of angler-hours of effort, by period, for each segment of the beach fisheries for chinook salmon in Resurrection Bay, 1988.

Segment	Period A	B	C	D	Total
WATERFALL BEACH					
Weekends					
Number of counts	4	5	4	5	18
Effort	353	592	683	519	2,147
Standard error	104.2	38.1	182.9	147.2	259.7
Weekdays					
Number of counts	4	6	2	6	18
Effort	503	963	875	1,313	3,654
Standard error	135.4	204.6	787.5	288.4	873.8
BOAT HARBOR BEACH					
Weekends:					
Number of counts	4	5	5	4	18
Effort	125	282	501	432	1,340
Standard error	43.1	109.0	143.9	156.0	242.4
Weekdays:					
Number of counts	4	5	2	7	18
Effort	963	717	875	1,138	3,693
Standard error	379.7	277.3	350.0	393.6	706.0
TOTAL					
Number of counts	16	21	13	22	72
Effort	1,944	2,554	2,934	3,402	10,834
Standard error	418.6	363.4	892.6	533.0	1,178.2

Table 9. Summary of the number of angler-hours of effort during each segment of the beach fisheries for chinook salmon in Resurrection Bay, 1988.

Stratum	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
WATERFALL BEACH				
Weekends	2,147	261.6	1,634 - 2,660	23.9%
Weekdays	3,654	873.8	1,941 - 5,367	46.9%
Total	5,801	912.1	4,013 - 7,589	30.8%
BOAT HARBOR BEACH				
Weekends	1,340	242.4	865 - 1,815	35.5%
Weekdays	3,693	706.1	2,309 - 5,077	37.5%
Total	5,033	746.5	3,570 - 6,496	29.1%
GRAND TOTAL	10,834	1,178.7	8,524 - 13,144	21.3%

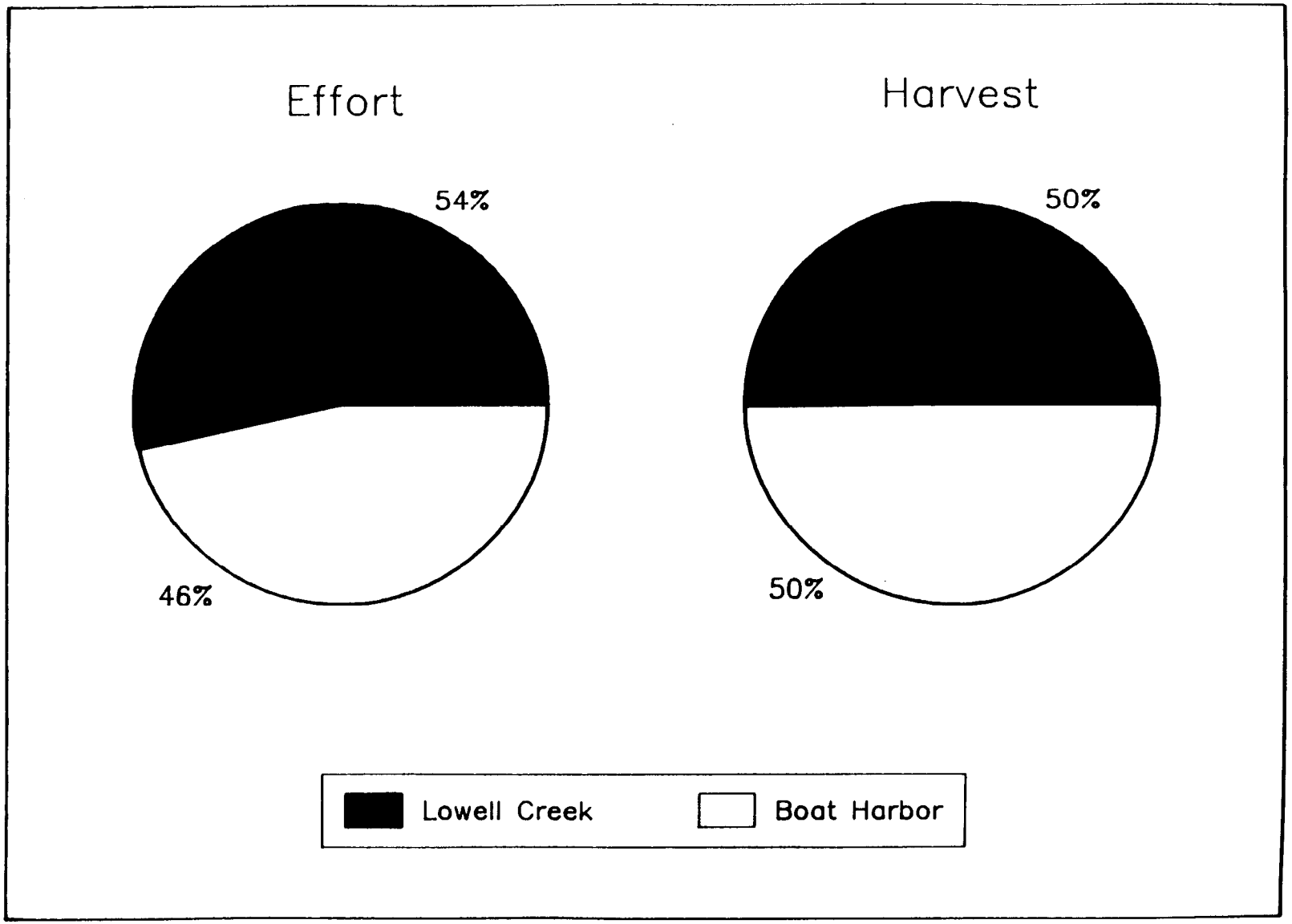

Figure 3. Percentage of chinook salmon harvest and effort by anglers fishing at the Lowell Creek and boat harbor beaches in Resurrection Bay, 1988.

The estimated harvest of chinook salmon per angler-hour was highest during the weekday strata at both beaches (Table 10). The highest harvest rate was observed at the boat harbor beach during the weekday stratum (0.15 chinook salmon harvested per angler-hour). Few chinook salmon were reported released by beach anglers. Daily summary statistics of mean effort and mean harvest per angler-hour for chinook salmon at each of the beaches are presented in Appendix Table 7. The harvest of chinook salmon was split approximately equally between the two beaches (Table 11, Figure 3). The percentage of the total harvest during weekdays was 75.0% (991 chinook salmon). While effort was distributed approximately in proportion to the time available on weekdays and weekends, the proportion of the harvest occurring on weekdays was somewhat higher than the time available on weekdays.

Coho Salmon:

Like the beach fishery for chinook salmon, proportionally more effort was expended during weekdays than weekends in the coho salmon beach fishery (Tables 12 and 13). Anglers fishing during weekdays expended 10,426 angler-hours of effort (62.1%) while anglers fishing during weekends expended 6,353 angler-hours of effort (37.9%). Of the four time periods, the most effort was expended during the B period when 5,139 angler-hours of effort were expended which was 30.6% of the total effort. Effort expended during the C, D, and A time periods was 4,903 angler-hours (29.2%), 3,661 angler-hours (21.8%), and 3,076 angler-hours (18.4%), respectively. Daily angler counts for the coho salmon beach fishery are summarized in Appendix Table 8.

The harvest of coho salmon per angler-hour was highest during the weekday stratum with 0.320 fish being harvested per angler-hour compared to 0.218 for the weekend stratum (Table 14). Few coho salmon were reported released by beach anglers. Daily summary statistics of mean effort, mean harvest per angler, and harvest per angler-hour for coho salmon are presented in Appendix Table 9. An estimated 4,718 coho salmon were harvested by beach anglers (Table 15). Both harvest and effort were distributed approximately in proportion to the time available on weekdays and weekends (Figure 4).

Biological Data

The majority (65%) of coho salmon harvested by the boat fishery were age 1.1[4] (Table 16). The mean length for age 1.1 males in the boat fishery varied from 612 mm during the Pre-Derby to 631 mm during the Post-Derby and the mean length for age 1.1 females varied from 589 mm during the Pre-Derby to 611 mm during the Post-Derby (Table 17). The mean length for age 2.1 males in the boat fishery varied from 593 mm during the Pre-Derby to 633 mm during the Derby and the mean length for age 2.1 females varied from 599 mm during the Derby to 610 during the Post-Derby (Table 17). Males comprised an estimated 64.3% of the total boat fishery harvest (Table 16).

[4] Numeral preceding the decimal represents the number of freshwater annuli and the numeral following the decimal represents the number of marine annuli (European method). Total age from brood year is the sum of the two numbers plus one.

Table 10. Estimated harvest of chinook salmon per angler-hour (HPUE) for each segment of the beach fisheries for chinook salmon in Resurrection Bay, 1988.

Stratum	Days d[1]	Days D[2]	Number of Interviews	Harvest[3] HPUE	Standard Error
WATERFALL BEACH					
Weekends	12	13	244	0.101	0.0162
Weekdays	13	25	206	0.122	0.0225
BOAT HARBOR BEACH					
Weekends	12	13	131	0.085	0.0216
Weekdays	13	25	211	0.147	0.0231

1 Number of days on which interviews were collected.

2 Number of days possible for collecting interviews.

3 Includes fish reported as kept only.

Table 11. Estimated number of chinook salmon harvested during each segment of the beach fisheries for chinook salmon in Resurrection Bay, 1988.

Stratum	Harvest[1]	Standard Error	95% Confidence Interval	Relative Precision
WATERFALL BEACH				
Weekends	217	43.5	132 - 302	39.3%
Weekdays	447	133.3	186 - 708	58.4%
Total	664	140.2	389 - 939	41.4%
BOAT HARBOR BEACH				
Weekends	114	35.2	45 - 183	60.5%
Weekdays	544	133.6	282 - 806	48.1%
Total	658	138.1	387 - 929	41.1%
GRAND TOTAL	1,322	196.8	936 - 1,708	29.2%

[1] Harvest includes only those fish reported as kept.

Table 12. Estimated number of angler-hours of effort, by period, for the beach fishery for coho salmon in Resurrection Bay, 1988.

Stratum	Period A	Period B	Period C	Period D	Total
SEWARD BEACH					
Weekends					
Number of counts	8	8	5	6	27
Effort	1,247	2,546	1,449	1,111	6,353
Standard error	284.6	494.2	423.1	343.3	788.7
Weekdays					
Number of counts	7	10	6	10	33
Effort	1,829	2,593	3,454	2,550	10,426
Standard error	464.2	491.0	1,215.5	532.8	1,489.2
TOTAL					
Number of counts	15	18	11	16	60
Effort	3,076	5,139	4,903	3,661	16,779
Standard error	544.5	696.6	1,287.0	633.8	1,685.2

Table 13. Summary of the number of angler-hours of effort during the beach fishery for coho salmon in Resurrection Bay, 1988.

Segment	Estimated Effort	Standard Error	95% Confidence Interval	Relative Precision
SEWARD BEACH				
Weekends	6,353	788.7	4,807 - 7,899	24.3%
Weekdays	10,426	1,489.2	7,507 - 13,345	28.0%
Total	16,779	1,685.2	13,476 - 20,082	19.7%

Table 14. Estimated harvest of coho salmon per angler-hour (HPUE) for the beach fishery for coho salmon in Resurrection Bay, 1988.

Stratum	Days d[1]	Days D[2]	Number of Interviews	Harvest[3] HPUE	Standard Error
SEWARD BEACH					
Weekends	15	15	548	0.218	0.0183
Weekdays	22	31	611	0.320	0.0361

1 Number of days on which interviews were collected.

2 Number of days possible for collecting interviews.

3 Includes fish reported as kept only.

Table 15. Estimated number of coho salmon harvested during the beach fishery for coho salmon in Resurrection Bay, 1988.

Stratum	Harvest[1]	Standard Error	95% Confidence Interval	Relative Precision
SEWARD BEACH				
Weekends	1,387	207.1	981 - 1,793	29.3%
Weekdays	3,331	604.2	2,147 - 4,515	35.6%
Total	4,718	638.7	3,466 - 5,970	26.5%

1 Harvest includes only those fish reported as kept.

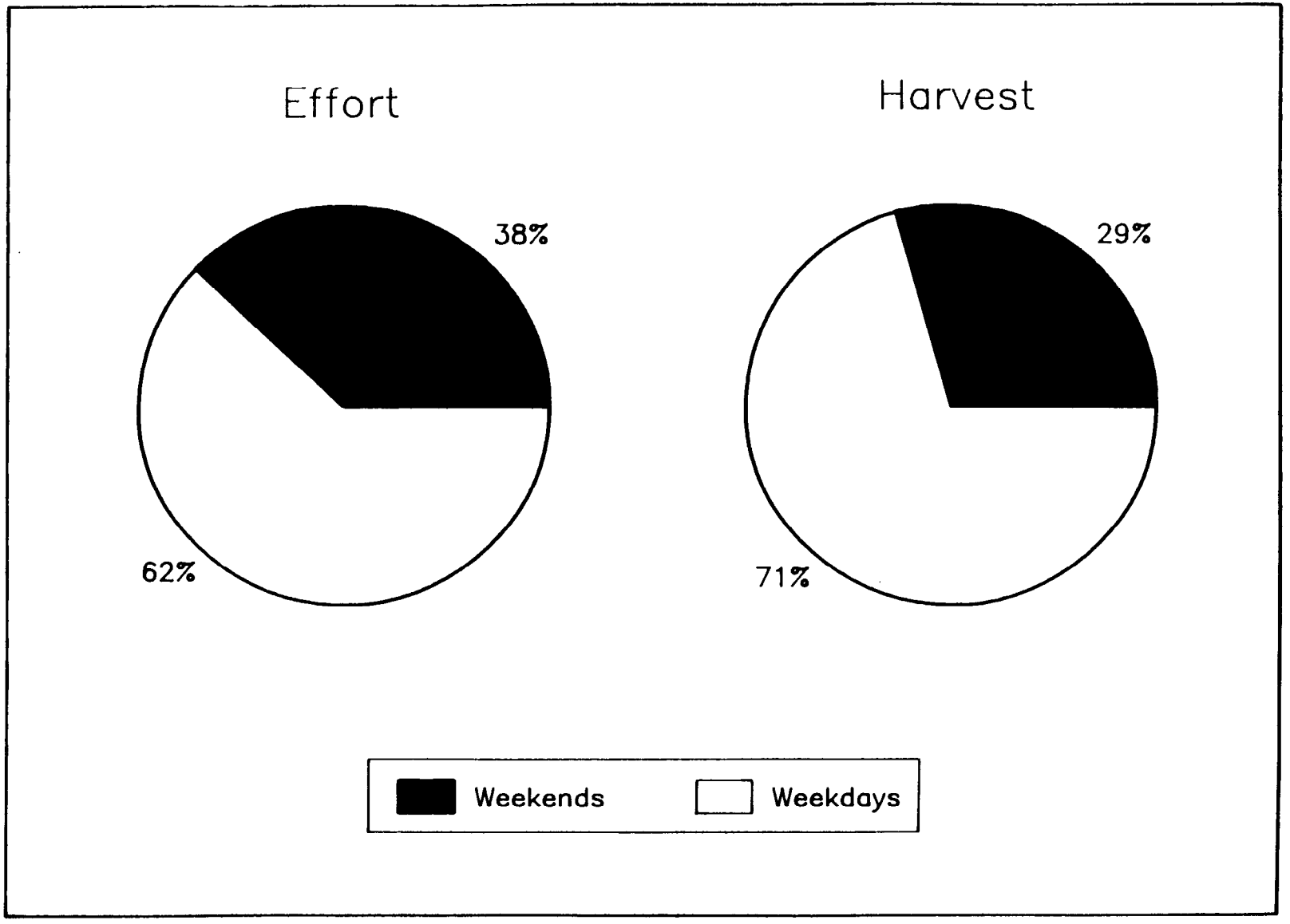

Figure 4. Percentage of coho salmon harvest and effort by anglers on weekends and weekdays during the beach fishery for coho salmon in Resurrection Bay, 1988.

Table 16. Estimated age composition and numbers by sex for the coho salmon harvest by the boat fishery in Resurrection Bay, 1988.

Period[1]	Sex		Brood Year/ Age Group 1985 1.1	1984 2.1	1983 3.1	Total
Pre-Derby (n = 129)	Male	Percent	43.4	11.6	0.8	55.8
		Number	1,244	333	23	1,600
		Standard error	204	91	23	--
	Female	Percent	31.8	12.4		44.2
		Number	912	356		1,268
		Standard error	167	95		--
	Combined	Percent	75.2	24.0	0.8	100.0
		Number	2,156	689	23	2,868
		Standard error	264	132	23	--
Derby (n = 185)	Male	Percent	41.1	27.0	0.5	68.6
		Number	1,892	1,243	23	3,158
		Standard error	195	164	24	--
	Female	Percent	17.9	13.5		31.4
		Number	824	622		1,446
		Standard error	137	120		--
	Combined	Percent	59.0	40.5	0.5	100.0
		Number	2,716	1,865	23	4,604
		Standard error	238	204	24	--
Post-Derby (n = 136)	Male	Percent	45.6	20.6		66.2
		Number	1,066	481		1,547
		Standard error	251	131		--
	Female	Percent	21.3	12.5		33.8
		Number	498	292		790
		Standard error	135	91		--
	Combined	Percent	66.9	33.1		100.0
		Number	1,564	773		2,337
		Standard error	285	160		--
Total	Male	Percent	42.8	21.0	0.5	64.3
		Number	4,202	2,057	46	6,305
		Standard error	378	229	33	--
	Female	Percent	22.8	12.9		35.7
		Number	2,234	1,270		3,504
		Standard error	255	178		--
	Combined	Percent	65.6	34.4		100.0
		Number	6,436	3,327		9,809
		Standard error	456	290		--

1 n = sample size.

Table 17. Mean length[1] by sex and age group of the coho salmon sampled from the sport harvest of boat anglers in Resurrection Bay, 1988.

Period	Sex		Brood Year/ Age Group 1985 1.1	1984 2.1	1983 3.1
Pre-Derby	Male	Length	612	593	610
		Standard error	5.6	12.1	---
		Sample size	56	15	1
	Female	Length	589	601	
		Standard error	7.8	11.1	
		Sample size	41	16	
Derby	Male	Length	630	633	605
		Standard error	7.1	8.4	---
		Sample size	76	50	1
	Female	Length	610	599	
		Standard error	7.3	12.3	
		Sample size	33	25	
Post-Derby	Male	Length	631	620	
		Standard error	4.3	10.0	
		Sample size	62	28	
	Female	Length	611	610	
		Standard error	6.8	7.8	
		Sample size	29	17	

1 Length measured from mid-eye to fork-of-tail in millimeters.

Age 0.3 chinook salmon accounted for 89.2% of the harvested chinook salmon at the beaches with ages 0.2, 0.4, and 0.1 accounting for 5.4%, 4.5%, and 0.9% of the harvest, respectively (Table 18). Females comprised 63.4% of the harvest. Mean lengths of harvested chinook salmon increased by age class (Table 19).

As in the boat fishery, most coho salmon harvested in the beach fishery were age 1.1. Age 1.1 fish comprised 72.0% of the coho salmon beach harvest and age 2.1 fish comprised 28.0% of the harvest (Table 20). Males comprised 62.4% of the harvest. The mean lengths for age 1.1 male and female coho salmon in the beach fishery were 619 mm and 629 mm respectively and for age 2.1 fish mean lengths were 612 mm and 623 mm respectively (Table 21).

Hatchery Contributions to the Fishery[5]

The Bear Lake coho salmon emigration of 80,182 smolts in 1987 (Vincent-Lang et al. 1988a) contributed adult coho salmon to the Resurrection Bay sport fishery and Bear Lake immigration in 1988. The majority of these smolts were from the 1985 and 1986 Bear Lake fingerling plants. Hatchery-reared smolts released in Seward Lagoon (65,500 smolts) and Lowell Creek (57,200 smolts) in 1987 also contributed to the sport fishery in 1988 (Vincent-Lang et al. 1988a).

Hatchery fish comprised an estimated 56% of the total recreational harvest of coho salmon in Resurrection Bay (Tables 22 and 23). Hatchery fish comprised approximately 43% of the boat fishery harvest and approximately 81% of the beach fishery harvest (Figure 5). The Seward Lagoon release site was the largest contributor to both fisheries followed in order by the Lowell Creek and Bear Lake release sites. As measured by percentage of smolts contributing to the harvest, the Seward Lagoon stocking was most efficient (6.3%) followed by Lowell Creek (5.8%) and Bear Lake (0.8%).

Chinook salmon returns in 1988 were from hatchery-reared smolts stocked at Thumb Cove in 1984 (70,000 fish), Lowell Creek outlet in 1984 (40,600 fish), 1985 (132,700 fish), 1986 (101,000 fish), and 1987 (96,000 fish), and Seward Lagoon in 1985[6] (53,200 fish). The estimated harvest of chinook salmon by the beach and boat sport fisheries was 1,322 and 89, respectively (Tables 7 and 11). Because no hatchery smolts of Crooked Creek origin were marked, it was not possible to partition the catch by release site. However, we believe it is likely that the vast majority are from the Lowell Creek release on the west shore of Resurrection Bay where the fishery takes place (Figure 1). The Thumb Cove release site is on the east shore of the bay and all fish returning from the single release at this site in 1984 were age 0.4; the harvest component of

[5] The data used to estimate the contributions of hatchery coho salmon from Bear Lake, Seward Lagoon, and Lowell Creek to the 1988 boat and beach fisheries is summarized in Appendix Table 10.

[6] Chinook salmon stocked at Seward lagoon in 1985 were of late run Kenai River origin. All of the smolt released were marked with an adipose fin-clip. Seven marked fish were recovered from the limited sport fishery in late July and early August.

Table 18. Estimated age composition and numbers by sex of hatchery chinook salmon harvested by beach anglers in Resurrection Bay, 1988.

Sex		Brood Year and Age Group				
		1986 0.1	1985 0.2	1984 0.3	1983 0.4	Total
Male	Percent	0.9	2.7	32.1	0.9	36.6
	Number	12	36	424	12	484
	Standard error	12	21	86	12	----
Female	Percent		2.7	57.1	3.6	63.4
	Number		36	755	48	839
	Standard error		21	128	24	----
Combined (n = 112)[1]	Percent	0.9	5.4	89.2	4.5	100.0
	Number	12	72	1,179	60	1,323
	Standard error	12	29	154	27	----

[1] n = sample size.

Table 19. Mean length[1] by sex and age group of hatchery chinook salmon sampled from the sport harvest of beach anglers in Resurrection Bay, 1988.

Sex		Brood Year and Age Group			
		1986 0.1	1985 0.2	1984 0.3	1983 0.4
Male	Length	550	608	790	835
	Standard Error		37.7	6.9	
	Sample Size	1	3	36	1
Female	Length		610	769	838
	Standard Error		9.8	5.6	13.9
	Sample Size		3	64	4

1 Length measured in millimeters from mid-eye to fork-of-tail.

Table 20. Estimated age composition and numbers by sex for coho salmon harvested by beach anglers in Resurrection Bay, 1988.

Sex		Brood Year and Age Group 1985 1.1	1984 2.1	Total
Male	Percent	47.2	15.2	62.4
	Number	2,227	717	2,944
	Standard error	367	179	--
Female	Percent	24.8	12.8	37.6
	Number	1,170	604	1,774
	Standard error	241	162	--
Combined (n = 149)[1]	Percent	72.0	28.0	100.0
	Number	3,397	1,321	4,718
	Standard error	439	242	--

1 n = sample size.

Table 21. Mean length[1] by sex and age group of coho salmon sampled from the sport harvest of beach anglers in Resurrection Bay, 1988.

Sex		Brood Year and Age Group	
		1985 1.1	1984 2.1
Male	Length	619	612
	Standard error	4.8	10.9
	Sample size	59	19
Female	Length	629	623
	Standard error	6.3	7.4
	Sample size	31	16

1 Length measured in millimeters from mid-eye to fork-of-tail.

Table 22. Estimated contribution of coho salmon from the Bear Lake, Seward Lagoon, and Lowell Creek release sites, by fishery segment, to the Resurrection Bay boat fishery, 1988.

Strata	Number	Standard Error	Covariance
PRE-DERBY & DERBY			
Bear Lake	463	64	-0.0004
Seward Lagoon	1,426	126	-0.0004
Lowell Creek	1,043	98	-0.0004
Total	2,932	172	
POST-DERBY			
Bear Lake	154	61	-0.0051
Seward Lagoon	640	166	-0.0051
Lowell Creek	532	140	-0.0051
Total	1,326	226	
SEASON			
Bear Lake	617	88	
Seward Lagoon	2,066	208	
Lowell Creek	1,575	171	
Total	4,258	283	

Table 23. Estimated contribution of coho salmon from the Bear Lake, Seward Lagoon, and Lowell Creek release sites to the Resurrection Bay boat and beach fisheries, 1988.

Source	Boat Fishery		Beach Fishery		Total[1]	
	Number	SE[2]	Number	SE[2]	Number	SE[2]
Bear Lake	617	88	0		617	88
Seward Lagoon	2,066	208	2,058	361	4,124	417
Lowell Creek	1,575	171	1,753	313	3,328	357
Total Enhanced	4,258	283	3,811	478	8,069	555
Wild[3]	5,551	733	907	798	6,458	1,083
Total Harvest	9,809	676	4,718	639	14,527	930

1 Total harvest by boat fisheries and beach fisheries combined.

2 Standard error.

3 Computed as the difference of total harvest less enhanced harvest.

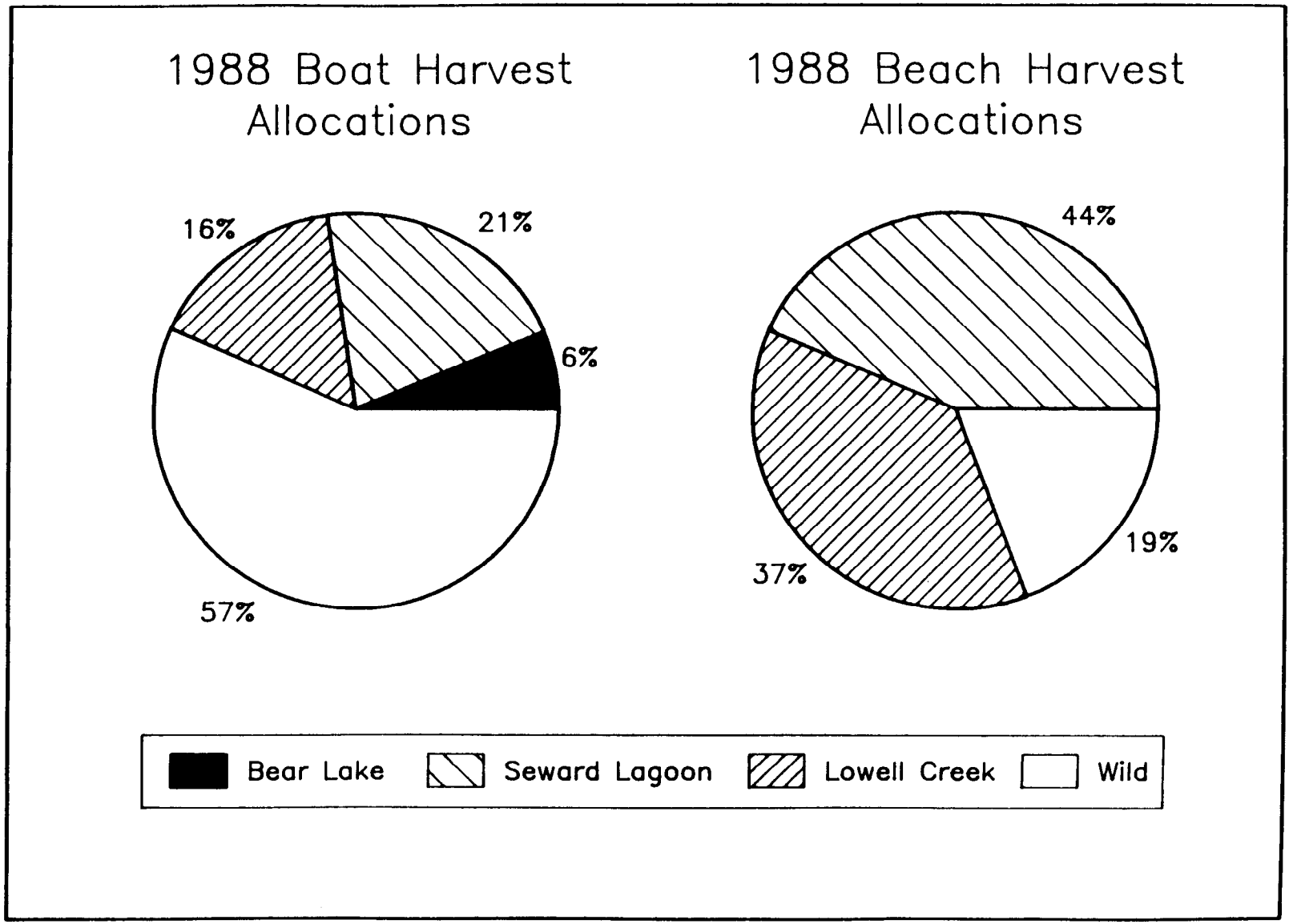

Figure 5. Estimated contribution of hatchery stocks to the coho salmon harvest of the Resurrection Bay boat and beach fisheries, 1988.

age 0.4 chinook salmon was small (4.5%). Likewise, the 1985 Seward Lagoon release of Kenai River late run fish did not contribute significantly as the return timing of these fish resulted in their return to the area after the main fishery had concluded and anglers began participating in other fisheries.

DISCUSSION

Effort in the boat fishery in 1988 (6,654 boat-trips) was below the 20-year average annual effort of 7,391 boat-trips (Figure 6). The harvest of 9,809 coho salmon by the boat fishery in 1988 approached the 20-year low harvest of 8,861 fish in 1968 (Figure 6). A decrease in both effort and harvest rate from historical averages (effort down 10%, harvest rate down 30%) resulted in the decreased harvest level. Contributing factors are not totally quantifiable at present, but it is likely that a major flood that occurred in late October of 1986 in the Resurrection Bay drainage adversely affected the survival of juvenile coho salmon that were rearing in freshwater habitats at the time. Ages 0+ and 1+ juveniles destined to return to the 1988 fishery as ages 1.1 and 2.1 adults would have experienced the flood in the freshwater environment. Some of the 1986 age 0+ juveniles are destined to return in 1989 as age 2.1 adults; any adverse affect of the 1986 flood will be reflected in the contribution of age 2.1 adults to the 1989 fishery.

Depressed ocean survival may also have contributed to the 1988 sub-average catch rate in the boat fishery. The Bear Lake smolt survival of 3.5% was lower than the 20-year average of 5.4%. Using this as an indicator, wild stocks may have experienced a similarly depressed ocean survival.

The harvest of coho salmon by the beach fishery in 1988 was 4,718 fish. This harvest is three times the 1987 harvest and more than double the 1986 harvest. A contributing factor to the increased harvest in 1988 was that the shore fishery for coho salmon remained open through emergency order past the historical closure date of 14 September. Partially as a result of this, effort in the 1988 fishery increased by 43% over the 1987 effort of 11,767 man-hours (Vincent-Lang et al. 1988b). Also, stocking intensity at sites contributing to this fishery increased to 123,000 fish. The numbers of smolts stocked in 1986 and 1987 to support this fishery were 50,200 and 52,500, respectively.

The recently developed beach fishery for chinook salmon continued its growth in 1988. Over 1,300 hatchery chinook salmon were harvested and 10,800 angler-hours of effort were expended in 1988. This more than doubled both the harvest and effort in this fishery during 1987 (Vincent-Lang et al. 1988b). For the first time since the enhanced fishery began on the Seward beaches, age 0.4 hatchery-reared chinook salmon were available for harvest. Although they made up only 4.5% of the harvest (Table 18), they were larger (mean length = 838 mm) than age 0.3 fish harvested in 1987 (mean length = 784 mm).

A total of seven fish of late run Kenai River origin were sampled from the limited sport harvest in late July and August. This was the first year in which chinook salmon from the 1985 experimental stocking of late run fish were recovered. Capture of these fish generated much local interest as their

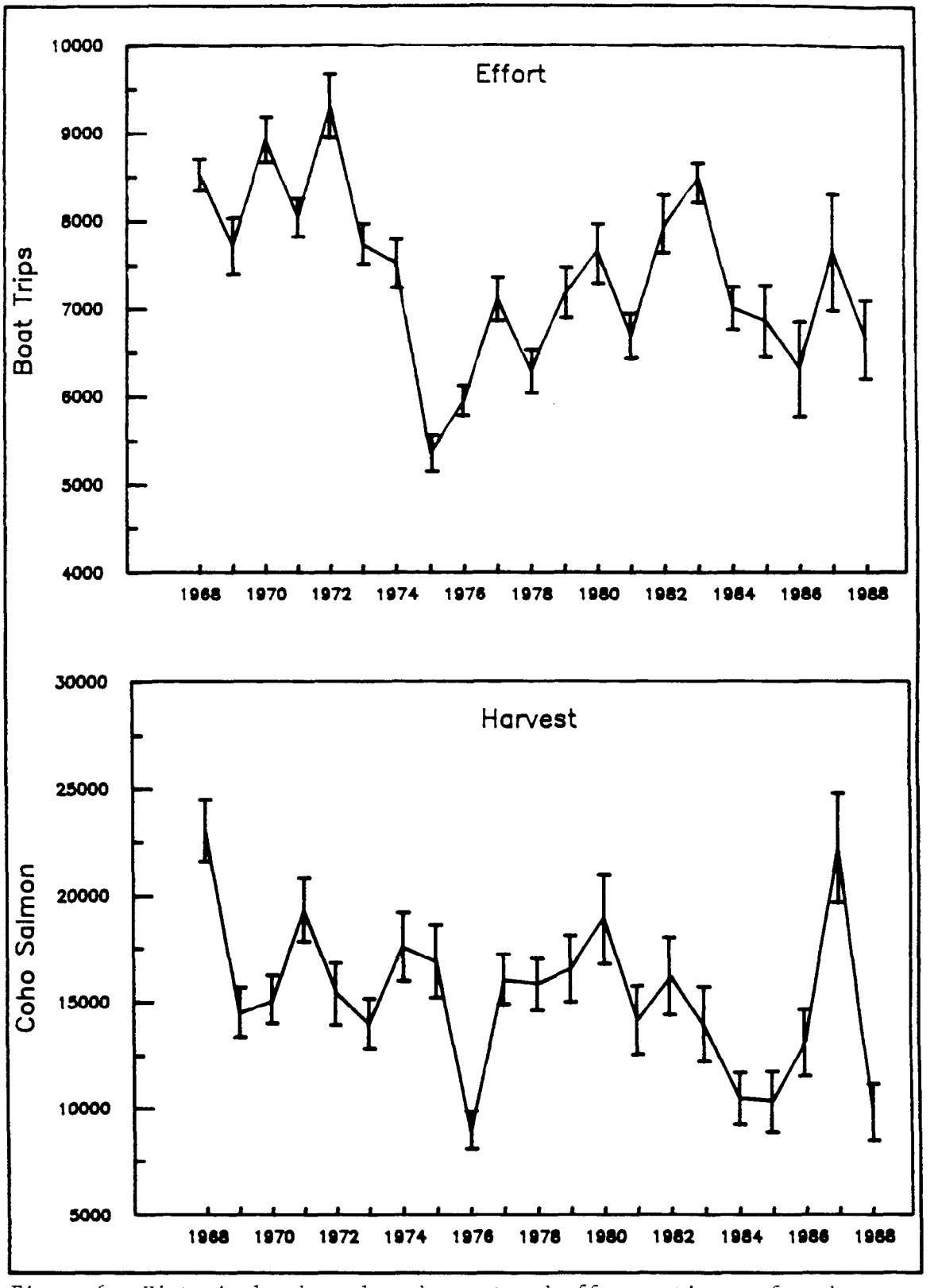

Figure 6. Historical coho salmon harvest and effort estimates for the Resurrection Bay boat fishery, 1968-1988 (vertical bars represent 95% confidence intervals).

timing extended the availability of chinook salmon, albeit in low numbers at present, and they were large fish (maximum length=1,015 mm). With continued stocking of late run fish, a viable fishery will likely develop around late run timing.

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APPENDIX

Appendix Table 1. Counts of private and charter boats made during the creel survey of the Resurrection Bay boat fishery, 1988.

Date	Wd/We[1]	Period A	B	C	D
7/01	Wd			5	
7/02	We		10	33	
7/03	We	5		44	29
7/04	We			16	6
7/05	Wd			6	6
7/06	Wd			4	6
7/07	Wd		9	15	
7/08	Wd				
7/09	We	5		20	
7/10	We		17		10
7/11	Wd		4		6
7/12	Wd			10	7
7/13	Wd	0		17	
7/14	Wd				
7/15	Wd				
7/16	We			76	21
7/17	We			34	17
7/18	Wd				
7/19	Wd				
7/20	Wd			26	4
7/21	Wd			17	11
7/22	Wd	1		23	
7/23	We				41
7/24	We		30		
7/25	Wd				
7/26	Wd				
7/27	Wd		10	28	
7/28	Wd		8	24	
7/29	Wd			19	21
7/30	We			56	45
7/31	We			76	39
8/01	Wd		3		
8/02	Wd	1		16	
8/03	Wd				
8/04	Wd				
8/05	Wd			25	17
8/06	We	5			36

-continued-

Appendix Table 1. Counts of private and charter boats made during the creel survey of the Resurrection Bay boat fishery, 1988 (continued).

Date	Wd/We[1]	Period A	B	C	D
8/07	We		33	29	
8/08	Wd				
8/09	Wd				
8/10	Wd			22	9
8/11	Wd		14	32	
8/12	Wd			27	33
8/13	We		64	243	109
8/14	We	28	121	194	55
8/15	Wd		66		32
8/16	Wd	6	88	92	24
8/17	Wd	12	61	127	68
8/18	Wd	6	60	91	51
8/19	Wd	17	102	147	50
8/20	We	21	75	259	111
8/21	We	151			
8/22	Wd				
8/23	Wd				
8/24	Wd	4	20		
8/25	Wd		24		
8/26	Wd			25	8
8/27	We		30		28
8/28	We			63	16
8/29	Wd				
8/30	Wd				
8/31	Wd	3			9
9/01	Wd		7	17	
9/02	Wd		10		15
9/03	We		27	71	
9/04	We		110		29
9/05	We	4		53	9
9/06	Wd		10	5	
9/07	Wd				
9/08	Wd				
9/09	Wd		10	7	
9/10	We			5	3
9/11	We	4	15		

1 Weekday (Wd) or weekend-holiday (We).

Appendix Table 2. Daily mean effort and coho salmon harvest per boat-trip for anglers fishing from private boats during the Resurrection Bay boat fishery, 1988.

Date	We/[1] Wd	No. Boats Interviewed	Mean Effort (hrs/trip)	SE Effort	Mean Harvest (harvest/trip)	SE Harvest
7/01	Wd	2	2.5	0.50	0.50	0.500
7/02	We	28	5.1	0.45	0.07	0.050
7/03	We	40	5.9	0.26	0.28	0.119
7/04	We	13	5.8	0.67	0.00	0.000
7/05	Wd	5	4.9	0.33	0.00	0.000
7/06	Wd	5	6.6	0.93	0.80	0.490
7/07	Wd	13	2.9	0.46	0.23	0.231
7/09	We	14	4.9	0.64	0.36	0.225
7/10	We	16	4.8	0.62	1.19	0.720
7/11	Wd	7	5.0	0.38	3.71	1.491
7/12	Wd	12	4.9	0.44	5.92	2.043
7/13	Wd	6	4.5	0.48	3.83	2.428
7/16	We	58	5.6	0.32	1.22	0.318
7/17	We	31	5.4	0.33	0.74	0.293
7/20	Wd	16	5.6	0.41	0.50	0.258
7/21	Wd	9	5.2	0.66	1.00	0.527
7/22	Wd	9	5.6	0.78	0.78	0.364
7/23	We	17	6.3	0.42	1.12	0.410
7/24	We	17	4.6	0.43	0.88	0.562
7/27	Wd	16	4.7	0.38	1.38	0.625
7/28	Wd	17	6.5	0.94	0.59	0.228
7/29	Wd	14	6.2	0.52	1.50	0.522
7/30	We	44	7.2	0.28	1.18	0.305
7/31	We	51	6.7	0.26	1.31	0.284
8/01	Wd	13	5.0	0.40	0.46	0.215
8/02	Wd	6	7.4	2.67	0.50	0.342
8/05	Wd	20	5.3	0.58	1.45	0.467
8/06	We	15	5.1	0.53	0.07	0.067
8/07	We	29	4.4	0.27	0.24	0.154
8/10	Wd	12	5.3	0.47	0.58	0.193
8/11	Wd	23	4.7	0.38	1.22	0.251
8/12	Wd	20	5.8	0.39	0.95	0.285
8/13	We	178	7.0	0.21	1.56	0.193
8/14	We	213	6.3	0.16	1.12	0.108
8/15	Wd	65	6.4	0.36	1.22	0.261
8/16	Wd	114	6.3	0.24	1.53	0.197
8/17	Wd	139	6.8	0.23	1.89	0.183
8/18	Wd	106	6.7	0.35	1.96	0.191
8/19	Wd	154	6.2	0.22	2.23	0.174
8/20	We	232	6.1	0.18	1.95	0.177

- continued -

Appendix Table 2. Daily mean effort and coho salmon harvest per boat-trip for anglers fishing from private boats during the Resurrection Bay boat fishery, 1988 (continued).

Date	We/Wd[1]	No. Boats Interviewed	Mean Effort (hrs/trip)	SE Effort	Mean Harvest (harvest/trip)	SE Harvest
8/21	We	48	3.6	0.24	1.67	0.351
8/24	Wd	15	4.3	0.48	3.00	1.151
8/25	Wd	13	3.6	0.25	0.85	0.222
8/26	Wd	25	5.3	0.45	0.76	0.284
8/27	We	25	5.0	0.45	1.24	0.357
8/28	We	53	5.9	0.35	1.57	0.284
8/31	Wd	3	1.3	0.33	0.00	0.000
9/01	Wd	12	7.2	2.15	0.58	0.260
9/02	Wd	12	5.5	1.04	3.25	1.508
9/03	We	35	4.7	0.35	1.54	0.431
9/04	We	47	4.4	0.38	1.45	0.374
9/05	We	36	5.3	0.36	1.78	0.485
9/06	Wd	6	3.2	0.94	3.83	2.535
9/09	Wd	14	3.0	0.67	1.07	0.855
9/10	We	2	2.5	0.50	2.00	2.000
9/11	We	11	2.7	0.33	2.91	1.604

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 3. Daily mean effort and coho salmon harvest per boat-trip for anglers fishing from charter boats during the Resurrection Bay boat fishery, 1988.

Date	We/1 Wd	No. Boats Interviewed	Mean Effort (hrs/trip)	SE Effort	Mean Harvest (harvest/trip)	SE Harvest
7/01	Wd	2	5.0	0.00	0.00	0.000
7/02	We	2	7.0	1.00	0.00	0.000
7/03	We	8	7.4	0.38	0.00	0.000
7/04	We	4	8.5	0.50	0.00	0.000
7/05	Wd	5	7.4	0.40	0.80	0.583
7/06	Wd	4	7.8	0.25	0.00	0.000
7/07	Wd	2	7.5	0.50	0.00	0.000
7/10	We	3	6.2	1.83	0.00	0.000
7/12	Wd	4	5.1	0.43	7.75	7.750
7/13	Wd	6	5.9	0.44	3.50	2.500
7/16	We	5	6.2	0.64	1.80	1.800
7/17	We	10	6.8	0.42	2.40	1.284
7/20	Wd	6	6.3	0.48	0.83	0.833
7/21	Wd	9	7.6	0.34	4.33	2.297
7/22	Wd	6	8.1	0.08	3.83	2.455
7/23	We	6	7.5	0.32	0.83	0.833
7/27	Wd	4	4.3	0.75	0.25	0.250
7/28	Wd	6	7.3	0.42	0.33	0.211
7/29	Wd	7	6.9	1.23	1.57	1.571
7/30	We	10	8.3	0.25	3.50	1.887
7/31	We	8	7.4	0.82	2.38	1.164
8/01	Wd	2	6.5	0.50	1.50	0.500
8/02	Wd	3	5.7	0.83	2.33	1.202
8/05	Wd	6	6.8	0.44	3.17	1.470
8/07	We	3	7.0	0.58	0.33	0.333
8/10	Wd	8	6.9	0.13	1.13	0.479
8/11	Wd	5	6.6	0.24	0.80	0.583
8/12	Wd	5	6.9	0.64	1.40	0.678
8/13	We	4	8.3	0.25	2.75	2.750
8/14	We	5	7.8	0.73	1.80	1.114
8/15	Wd	2	8.0	0.00	0.00	0.000
8/16	Wd	5	7.2	1.02	2.40	1.166
8/17	Wd	8	7.5	1.04	1.63	0.778
8/18	Wd	8	8.4	0.86	2.13	1.043
8/19	Wd	3	6.7	1.45	4.00	1.155
8/20	We	5	7.2	0.86	2.20	1.241
8/25	Wd	2	4.0	0.00	3.00	2.000
8/27	We	5	5.9	1.36	1.00	0.447
8/28	We	3	6.5	1.04	0.00	0.000
8/31	Wd	2	4.0	2.00	3.00	3.000
9/03	We	3	5.8	1.36	2.33	1.856
9/05	We	4	8.3	0.92	0.00	0.000

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 4. Daily mean effort and coho salmon harvest per boat-trip for anglers fishing from private and charter boats during the Resurrection Bay boat fishery, 1988.

Date	We/Wd[1]	No. Boats Interviewed	Mean Effort (hrs/trip)	SE Effort	Mean Harvest (harvest/trip)	SE Harvest
7/01	Wd	4	3.8	0.75	0.25	0.250
7/02	We	30	5.3	0.43	0.07	0.046
7/03	We	48	6.1	0.24	0.23	0.100
7/04	We	17	6.4	0.59	0.00	0.000
7/05	Wd	10	6.2	0.48	0.40	0.306
7/06	Wd	9	7.1	0.54	0.44	0.294
7/07	Wd	15	3.5	0.58	0.20	0.200
7/09	We	15	5.1	0.63	0.33	0.211
7/10	We	19	5.0	0.58	1.00	0.612
7/11	Wd	7	5.0	0.38	3.71	1.491
7/12	Wd	16	5.0	0.34	6.38	2.311
7/13	Wd	12	5.2	0.38	3.67	1.662
7/16	We	63	5.7	0.30	1.27	0.320
7/17	We	41	5.8	0.28	1.15	0.390
7/20	Wd	22	5.8	0.33	0.59	0.284
7/21	Wd	18	6.4	0.46	2.67	1.213
7/22	Wd	15	6.6	0.57	2.00	1.033
7/23	We	23	6.6	0.33	1.04	0.364
7/24	We	18	4.6	0.41	0.83	0.532
7/27	Wd	22	4.2	0.42	1.05	0.467
7/28	Wd	24	6.5	0.73	0.50	0.170
7/29	Wd	21	6.4	0.52	1.52	0.604
7/30	We	54	7.4	0.24	1.61	0.435
7/31	We	59	6.8	0.25	1.46	0.290
8/01	Wd	15	5.2	0.37	0.60	0.214
8/02	Wd	10	6.2	1.72	1.00	0.471
8/05	Wd	26	5.7	0.47	1.85	0.498
8/06	We	17	4.9	0.57	0.06	0.059
8/07	We	36	4.1	0.35	0.22	0.127
8/10	Wd	22	5.6	0.40	0.73	0.210
8/11	Wd	28	5.0	0.35	1.14	0.228
8/12	Wd	27	5.5	0.44	0.96	0.247
8/13	We	186	7.0	0.21	1.55	0.192
8/14	We	222	6.2	0.16	1.15	0.109
8/15	Wd	67	6.4	0.35	1.18	0.254
8/16	Wd	120	6.3	0.24	1.55	0.194
8/17	Wd	149	6.8	0.22	1.85	0.176
8/18	Wd	114	6.8	0.33	1.97	0.190
8/19	Wd	157	6.2	0.21	2.26	0.173
8/20	We	238	6.1	0.18	1.95	0.174

-continued-

Appendix Table 4. Daily mean effort and coho salmon harvest per boat-trip for anglers fishing from private and charter boats during the Resurrection Bay boat fishery, 1988 (continued).

Date	We/Wd[1]	No. Boats Interviewed	Mean Effort (hrs/trip)	SE Effort	Mean Harvest (harvest/trip)	SE Harvest
8/21	We	50	3.5	0.25	1.60	0.340
8/24	Wd	17	4.1	0.49	2.76	1.027
8/25	Wd	15	3.7	0.22	1.13	0.336
8/26	Wd	26	5.4	0.44	0.81	0.277
8/27	We	31	5.0	0.45	1.16	0.297
8/28	We	56	5.9	0.33	1.48	0.273
8/31	Wd	8	1.5	0.71	0.75	0.750
9/01	Wd	13	6.7	2.05	0.54	0.243
9/02	Wd	14	4.7	1.04	2.79	1.323
9/03	We	38	4.8	0.34	1.61	0.416
9/04	We	48	4.3	0.38	1.42	0.367
9/05	We	42	5.3	0.39	1.52	0.426
9/06	Wd	7	3.1	0.80	5.00	2.440
9/09	Wd	14	3.0	0.67	1.07	0.855
9/10	We	2	2.5	0.50	2.00	2.000
9/11	We	11	2.7	0.33	2.91	1.604

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 5. Daily harvest of chinook salmon, halibut, and lingcod per boat-trip for anglers fishing from private and charter boats during the Resurrection Bay boat fishery, 1988.

Date	We/Wd[1]	Chinook Salmon		Halibut		Lingcod	
		Harvest	SE	Harvest	SE	Harvest	SE
7/01	Wd	0.00	0.000	0.75	0.479	1.25	0.946
7/02	We	0.00	0.000	0.97	0.297	0.77	0.278
7/03	We	0.00	0.000	0.85	0.233	0.69	0.198
7/04	We	0.00	0.000	0.88	0.401	1.82	0.626
7/05	Wd	0.00	0.000	1.10	0.547	1.60	0.872
7/06	Wd	0.00	0.000	2.11	0.611	0.67	0.333
7/07	Wd	0.20	0.200	0.47	0.192	1.20	0.818
7/09	We	0.00	0.000	0.60	0.306	0.80	0.393
7/10	We	0.00	0.000	1.21	0.456	1.16	0.603
7/11	Wd	0.00	0.000	0.14	0.143	0.71	0.565
7/12	Wd	0.06	0.063	0.94	0.403	0.50	0.258
7/13	Wd	0.08	0.083	1.92	0.657	0.25	0.131
7/16	We	0.00	0.000	1.43	0.302	0.21	0.088
7/17	We	0.00	0.000	1.20	0.301	0.56	0.213
7/20	Wd	0.05	0.045	0.91	0.360	0.68	0.344
7/21	Wd	0.06	0.056	1.78	0.799	0.22	0.101
7/22	Wd	0.00	0.000	1.60	0.542	0.40	0.273
7/23	We	0.04	0.043	1.74	0.675	0.30	0.132
7/24	We	0.00	0.000	0.67	0.388	0.22	0.222
7/27	Wd	0.00	0.000	0.41	0.204	0.32	0.191
7/28	Wd	0.00	0.000	0.33	0.130	0.46	0.340
7/29	Wd	0.00	0.000	0.95	0.327	0.67	0.536
7/30	We	0.00	0.000	0.96	0.280	0.44	0.216
7/31	We	0.00	0.000	0.85	0.250	0.39	0.186
8/01	Wd	0.00	0.000	0.13	0.091	0.00	0.000
8/02	Wd	0.00	0.000	1.00	0.699	0.00	0.000
8/05	Wd	0.04	0.038	0.73	0.312	0.69	0.467
8/06	We	0.00	0.000	0.94	0.348	0.94	0.591
8/07	We	0.00	0.000	0.06	0.039	0.64	0.382
8/10	Wd	0.00	0.000	1.05	0.429	0.18	0.107
8/11	Wd	0.00	0.000	0.36	0.220	0.64	0.314
8/12	Wd	0.00	0.000	0.63	0.378	0.67	0.389
8/13	We	0.02	0.013	0.27	0.097	0.28	0.091
8/14	We	0.00	0.000	0.22	0.062	0.21	0.078
8/15	Wd	0.03	0.021	0.22	0.118	0.40	0.152
8/16	Wd	0.03	0.019	0.05	0.035	0.09	0.058
8/17	Wd	0.01	0.009	0.03	0.021	0.05	0.035
8/18	Wd	0.00	0.000	0.15	0.067	0.04	0.036
8/19	Wd	0.02	0.014	0.01	0.006	0.00	0.000
8/20	We	0.01	0.006	0.03	0.016	0.04	0.027

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Appendix Table 5. Daily harvest of chinook salmon, halibut, and lingcod per boat-trip for anglers fishing from private and charter boats during the Resurrection Bay boat fishery, 1988 (continued).

Date	We/ Wd[1]	Chinook Salmon		Halibut		Lingcod	
		Harvest	SE	Harvest	SE	Harvest	SE
8/21	We	0.00	0.000	0.00	0.000	0.00	0.000
8/24	Wd	0.00	0.000	0.00	0.000	0.00	0.000
8/25	Wd	0.00	0.000	0.00	0.000	0.00	0.000
8/26	Wd	0.00	0.000	0.12	0.064	0.04	0.038
8/27	We	0.00	0.000	0.00	0.000	0.71	0.374
8/28	We	0.04	0.036	0.18	0.085	0.16	0.119
8/31	Wd	0.00	0.000	0.00	0.000	0.00	0.000
9/01	Wd	0.00	0.000	0.54	0.538	0.23	0.231
9/02	Wd	0.00	0.000	0.07	0.071	0.07	0.071
9/03	We	0.00	0.000	0.26	0.134	0.39	0.191
9/04	We	0.08	0.083	0.06	0.035	0.23	0.209
9/05	We	0.00	0.000	0.29	0.104	0.62	0.321
9/06	Wd	0.00	0.000	0.00	0.000	1.00	1.000
9/09	Wd	0.00	0.000	0.07	0.071	0.50	0.500
9/10	We	0.00	0.000	0.00	0.000	0.00	0.000
9/11	We	0.00	0.000	0.09	0.091	0.45	0.455

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 6. Counts of anglers made during the creel survey of the beach fishery for chinook salmon in Resurrection Bay, 1988.

Date	Wd/We[1]	Waterfall Beach				Boat Harbor Beach			
		A	B	C	D	A	B	C	D
6/03	Wd		6				2		
6/04	We	13	11			0	2		
6/06	Wd			19				14	
6/08	Wd				12				38
6/09	Wd	10				24			
6/11	We				10			22	14
6/12	We			21				14	
6/16	Wd		10		30		9		6
6/17	Wd		12		14		6		15
6/18	We			22				6	
6/19	We	2			23	3			15
6/22	Wd	3				7			
6/23	Wd		12		12		20		12
6/24	Wd								12
6/25	We		13	12	10		13	8	
6/26	We		16				3		
6/27	Wd	6	21			7			
6/28	Wd			1	16			6	6
7/02	We				11				9
7/03	We	10				4			
7/04	We	6	12			4	2		
7/06	Wd		5				4		
7/07	Wd	4			6	6			2
7/09	We		13		3		11		0
7/10	We			5				5	

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 7. Daily mean effort, mean chinook salmon harvest, and chinook salmon harvest per angler-hour (HPUE) for anglers fishing in the beach fishery for chinook salmon in Resurrection Bay, 1988.

Date	We/Wd[1]	Sample Size	Mean Effort (Hours)	SE Effort	Mean Harvest	SE Harvest	Harvest HPUE
Waterfall Beach							
6/03	Wd	5	0.7	0.22	0.00	0.000	0.000
6/04	We	23	1.4	0.16	0.04	0.043	0.031
6/06	Wd	22	1.3	0.13	0.18	0.084	0.138
6/08	Wd	10	0.8	0.13	0.00	0.000	0.000
6/09	Wd	9	1.4	0.26	0.00	0.000	0.000
6/11	We	13	2.3	0.54	0.23	0.166	0.098
6/12	We	31	1.5	0.19	0.39	0.110	0.262
6/16	Wd	31	1.2	0.19	0.26	0.092	0.211
6/17	Wd	20	1.4	0.28	0.05	0.050	0.036
6/18	We	24	2.9	0.51	0.29	0.112	0.100
6/19	We	27	1.5	0.20	0.22	0.111	0.144
6/22	Wd	3	0.5	0.00	0.00	0.000	0.000
6/23	Wd	35	1.2	0.20	0.23	0.092	0.186
6/25	We	40	2.1	0.38	0.07	0.055	0.036
6/26	We	16	1.5	0.24	0.13	0.085	0.083
6/27	Wd	28	2.1	0.43	0.32	0.104	0.155
6/28	Wd	24	1.4	0.31	0.17	0.078	0.115
7/02	We	16	2.0	0.35	0.06	0.063	0.032
7/03	We	12	1.3	0.32	0.08	0.083	0.063
7/04	We	19	1.1	0.17	0.11	0.072	0.094
7/06	Wd	6	2.5	1.14	0.00	0.000	0.000
7/07	Wd	13	1.1	0.14	0.08	0.077	0.069
7/09	We	18	1.5	0.24	0.28	0.135	0.185
7/10	We	5	0.8	0.22	0.00	0.000	0.000
Boat Harbor Beach							
6/03	Wd	2	0.5	0.00	0.00	0.000	0.000
6/04	We	4	0.8	0.29	0.00	0.000	0.000
6/06	Wd	12	1.1	0.16	0.25	0.131	0.231
6/08	Wd	35	2.3	0.38	0.23	0.083	0.099
6/09	Wd	24	2.1	0.34	0.29	0.127	0.140
6/11	We	16	2.5	0.59	0.06	0.063	0.025
6/12	We	23	2.1	0.35	0.13	0.072	0.063
6/16	Wd	10	0.5	0.06	0.00	0.000	0.000
6/17	Wd	11	1.5	0.29	0.18	0.122	0.125
6/18	We	8	1.3	0.46	0.38	0.183	0.286
6/19	We	19	1.9	0.34	0.32	0.134	0.168
6/22	Wd	7	0.9	0.07	0.43	0.202	0.462
6/23	Wd	29	2.8	0.52	0.52	0.094	0.184
6/24	Wd	26	1.3	0.25	0.31	0.092	0.232

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Appendix Table 7. Daily mean effort, mean chinook salmon harvest, and chinook salmon harvest per angler-hour (HPUE) for anglers fishing in the beach fishery for chinook salmon in Resurrection Bay, 1988 (continued).

Date	We/Wd[1]	Sample Size	Mean Effort (Hours)	SE Effort	Mean Harvest	SE Harvest	Harvest HPUE
Boat Harbor Beach							
6/25	We	20	1.9	0.49	0.00	0.000	0.000
6/26	We	3	1.3	0.43	0.00	0.000	0.000
6/27	Wd	18	1.6	0.33	0.28	0.135	0.169
6/28	Wd	22	2.1	0.46	0.23	0.091	0.110
7/02	We	8	1.3	0.31	0.38	0.263	0.300
7/03	We	5	0.9	0.18	0.00	0.000	0.000
7/04	We	9	2.1	0.61	0.00	0.000	0.000
7/06	Wd	5	1.2	0.34	0.00	0.000	0.000
7/07	Wd	10	1.1	0.20	0.00	0.000	0.000
7/09	We	11	1.4	0.26	0.18	0.122	0.127
7/10	We	5	1.1	0.24	0.40	0.245	0.364

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 8. Counts of anglers during the beach fishery for coho salmon in Resurrection Bay, 1988.

Date	Wd/We[1]	Period A	Period B	Period C	Period D
8/13	We	3		37	
8/14	We		42		14
8/15	Wd	17			
8/16	Wd			26	
8/17	Wd			68	9
8/18	Wd		37		
8/19	Wd	26			19
8/20	We		100		35
8/21	We	24			
8/24	Wd			17	
8/25	Wd	8			1
8/26	Wd		30		
8/27	We			21	
8/28	We	20	27		
8/31	Wd		31		43
9/01	Wd	18			31
9/03	We				44
9/04	We		41		
9/05	We		58		
9/06	Wd	36			30
9/09	Wd				19
9/10	We	43	64		
9/11	We			47	23
9/12	Wd			64	
9/13	Wd		50		49
9/14	Wd		27		
9/15	Wd		17		
9/16	Wd				27
9/19	Wd		11		7
9/20	Wd	10	25		
9/21	Wd	3		12	
9/26	Wd		5	4	
9/27	Wd		6		

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 9. Daily mean effort, mean coho salmon harvest, and coho salmon harvest per angler-hour (HPUE) for anglers fishing in the beach fishery for coho salmon in Resurrection Bay, 1988.

Date	We/Wd[1]	Sample Size	Mean Effort (Hours)	SE Effort	Mean Harvest	SE Harvest	Harvest CPUE
8/13	We	21	2.7	0.68	0.10	0.066	0.035
8/14	We	25	3.2	0.42	0.08	0.055	0.025
8/15	Wd	11	0.8	0.11	0.00	0.000	0.000
8/16	Wd	15	5.3	0.94	0.00	0.000	0.000
8/17	Wd	77	3.2	0.33	0.06	0.034	0.020
8/18	Wd	53	2.6	0.26	0.11	0.044	0.044
8/19	Wd	14	4.2	1.04	0.00	0.000	0.000
8/20	We	99	3.1	0.29	0.08	0.034	0.026
8/21	We	16	1.9	0.23	0.00	0.000	0.000
8/24	Wd	17	4.2	0.70	1.00	0.402	0.238
8/25	Wd	9	0.7	0.10	0.00	0.000	0.000
8/26	Wd	23	1.8	0.41	0.00	0.000	0.000
8/27	We	17	4.3	0.65	0.12	0.081	0.027
8/28	We	37	1.7	0.21	0.03	0.027	0.016
8/31	Wd	46	2.5	0.35	1.30	0.181	0.515
9/01	Wd	37	1.8	0.26	0.54	0.180	0.309
9/03	We	27	3.0	0.54	1.07	0.297	0.355
9/04	We	32	3.2	0.43	0.75	0.254	0.234
9/05	We	24	2.6	0.30	1.58	0.329	0.601
9/06	Wd	50	2.0	0.23	1.40	0.265	0.704
9/09	Wd	13	3.3	0.67	1.23	0.426	0.376
9/10	We	60	1.9	0.19	1.12	0.170	0.590
9/11	We	47	2.7	0.28	0.96	0.217	0.351
9/12	Wd	44	3.7	0.28	1.48	0.214	0.396
9/13	Wd	71	2.5	0.23	1.42	0.205	0.570
9/14	Wd	22	1.5	0.17	0.68	0.290	0.458
9/15	Wd	11	1.9	0.35	0.82	0.400	0.439
9/16	Wd	21	2.0	0.37	1.52	0.306	0.771
9/17	We	65	2.9	0.22	0.78	0.134	0.275
9/18	We	48	1.7	0.16	0.63	0.167	0.375
9/19	Wd	17	1.7	0.27	0.88	0.296	0.513
9/20	Wd	29	1.8	0.37	1.03	0.265	0.571
9/21	Wd	16	1.7	0.39	1.88	0.612	1.132
9/24	We	12	1.0	0.19	0.25	0.179	0.240
9/25	We	18	1.6	0.37	0.33	0.181	0.207
9/26	Wd	9	0.7	0.11	0.00	0.000	0.000
9/27	Wd	6	2.8	0.60	0.17	0.167	0.061

1 Weekend-Holiday (We) or weekday (Wd).

Appendix Table 10. Summary of data used to calculate the estimated contribution of Bear Lake, Seward Lagoon, and Lowell Creek coho salmon to the Resurrection Bay boat and beach fisheries, 1988.

Fishery	Stock	Variable[1]						
		a_1	a_2	m_1	m_2	m_c	n_2	θ_s
Boat: Pre-Derby & Derby Strata								
	Bear Lake-1987	427	410	401	400	55	2,480	0.37[3]
	Seward Lagoon-1987	427	410	401	400	188	2,480	0.41
	Lowell Creek-1987	427	410	401	400	152	2,480	0.46
	Other[2]	427	410	401	400	5	2,480	
Boat: Post-Derby Stratum								
	Bear Lake-1987	110	81	79	79	8	442	0.37[3]
	Seward Lagoon-1987	110	81	79	79	37	442	0.41
	Lowell Creek-1987	110	81	79	79	34	442	0.46
Beach								
	Seward Lagoon-1987	215	101	99	99	51	600	0.41
	Lowell Creek-1987	215	101	99	99	48	600	0.46

1 See text for definition of variables.
2 Strays from stockings outside of Resurrection Bay, disregarded in analyses.
3 θ_s calculated as the proportion of adipose clipped fish observed in the Bear Lake escapement (812/2,174), Carlon and Vincent-Lang (in press).